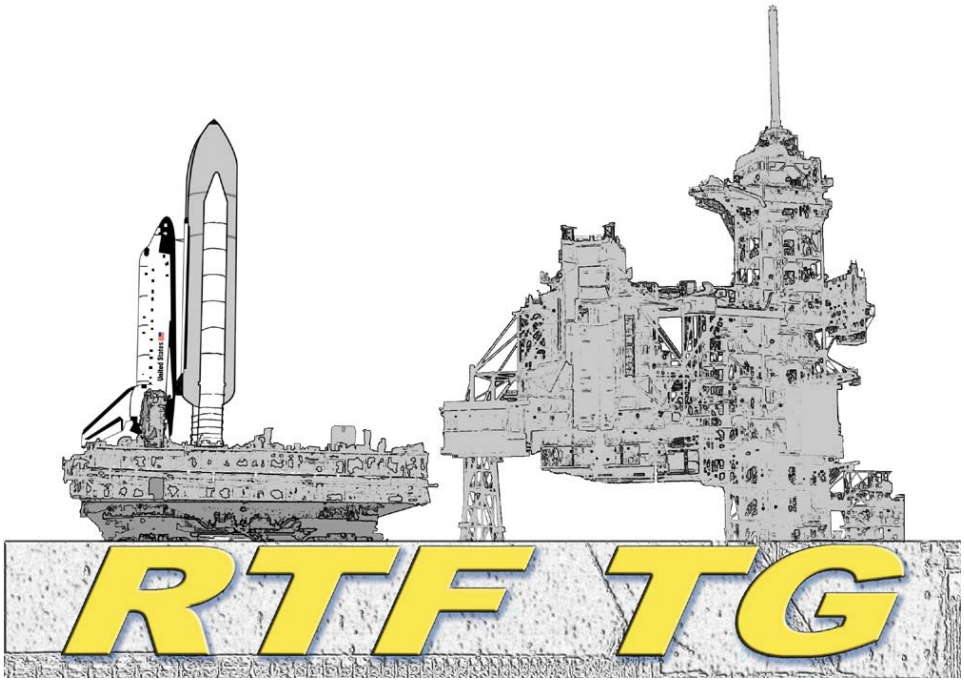
Interim Report

Return to Flight Task Group



January 20, 2004

THIS PAGE INTENTIONALLY LEFT BLANK

Return to Flight Task Group

Approved by

Original signed by Richard O. Covey
Richard O. Covey
Task Group Co-Chairman

January 20, 2004
Date

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

Appendices

SUMMARY

The Columbia Accident Investigation Board uncovered some very specific conditions that led to the demise of the Columbia along with some process and management structures that contributed to the accident. In a sense, the loss of the Columbia was caused by faulty assumptions, two to be precise:

1. Foam shed from the External Tank (ET) would be "transported" around the leading edge of the wing by the aerodynamics of the shuttle; and,

2. The foam was not substantial enough to develop a ballistic moment capable of puncturing the material (RCC) composing the leading edge of the wing.

It turns out that both assumptions, long-held and widely-shared within NASA were wrong, despite previous launches where foam was shed and little damage done—seemingly validating the assumptions. Thus, the "conditioned" response of senior managers to more junior members, who questioned these assumptions after the Columbia launched, was one of discouraging dissent and of comfort with established technical and operational assumptions, a problem exacerbated by systemic failures that precluded critical information getting to the right people at the right time.

In this light, the technical and operational challenges for NASA are to rectify the consequences of these faulty assumptions by, for example, removing foam debris sources, enhancing photography, improving on-orbit inspections, and developing on-orbit Thermal Protection System (TPS) repair. The primary challenge for NASA's management is to devise an organization with embedded processes to identify other faulty assumptions.

The Return-to-Flight Task Group (RTF TG) is charged with assessing the implementation of both the specific and general CAIB recommendations. The RTF TG is not in the business of suggesting specific remedies. As one member put it: we are in the position of an umpire calling balls and strikes in a zone defined by the CAIB recommendations. We are not in the position of evaluating the overall readiness or safety of the next flight, just the implementation of the return-to-flight CAIB recommendations.

Because of the substantial changes to foam insulation and inspection techniques for the external tank and the current lack of understanding of the foam shedding phenomena, the STS-114 ascent must be considered a test flight. As such, the RTF TG expects NASA to capture as much test data as possible during ascent, particularly in regards to the imaging recommendations of the CAIB.

NASA has responded to all the recommendations the CAIB identified for accomplishment before the next shuttle flight (See: NASA's Implementation Plan for Space Shuttle Return to Flight and Beyond, Revision 1.1). This report is based on materials available to the RTF TG as of December 10, 2003. Not surprisingly, the progress on the many recommendations is uneven. Several of the technical responses to specific recommendations have made substantial progress, although none have been completed. Others, such as preparation of a detailed plan for the implementation of an Independent Technical Engineering Authority (ITEA), are still in planning and some time away

from implementation and a long time away from evaluation.

While the tone of this interim report is justifiably positive, progress should not be mistaken for accomplishment. As time passes and the interval before the next scheduled flight diminishes, the enormity of the remaining task looms. Detailed plans for many of the recommendations have not been forthcoming. NASA has not been timely in some of their responses to Task Group requests for information. And while some of the most critical organizational issues raised by CAIB require only a "detailed plan" before return-to-flight, the RTF TG will be looking for thorough plans and processes that will stand the test of time—not just suffice for the first launch—just as the hardware redesigns are expected to serve the life of the shuttle.

The organization and content of this report are intended to begin the task of laying out for the public and for NASA what the RTF TG will expect, both in content and process, and offers the beginning of metrics to judge progress and completion. It is still much too soon to predict either the success of implementation or the timing of the next flight.

INTRODUCTION

The Return to Flight Task Group

On April 14, 2003, the NASA Administrator, Sean O'Keefe, tasked Lieutenant General Thomas Stafford, U.S. Air Force (USAF, Ret) with conducting an independent assessment of NASA's actions to implement the recommendations of the Columbia Accident Investigation Board (CAIB). As a result, a Return to Flight Task Group (RTF TG) was chartered under the Federal Advisory Committee Act (FACA). Mr. Richard Covey and Lt. Gen. Thomas Stafford were asked to co-chair this committee. Using expertise from the Stafford-International Space Station Operational Readiness Task Force, personnel from the aerospace industry, federal government, academia, and the military, the RTF TG is reviewing the actions of the Agency in implementing the CAIB recommendations. They will report their evaluations to the Space Flight Leadership Council (SFLC) and deliver a final report to the NASA Administrator one month before the planned return to flight of the Space Shuttle. This report is strictly advisory to the Administrator and not a prerequisite for return to flight.

While the Task Group is ancillary to the CAIB, it is a modest enterprise by comparison—all RTF TG members are part-time; the support staff is significantly smaller; outside consultants will be rare; the impingement on NASA resources will be small; and the budget is a fraction of the CAIB's

Federal Advisory Committee Act

NASA is among several federal agencies that currently enlarge their access to the insights and experiences of accomplished citizens by establishing advisory committees. The FACA governs the creation, management, and termination of such advisory committees when they report directly to federal officials. The General Services Administration provides government-wide administrative guidance for FACA, while the Office of Government Ethics oversees "conflict of interest" matters as they impact the designation and conduct of advisory committee members.

The legislative history of FACA (Public Law 92-463, 1972) makes it clear that Congress intended with this statue to lift the "veil of secrecy" surrounding over 35,000 then-existing federal advisory committees, ensuring that such groups did not function for purposes other than "giving advice." Examples of "other purposes" which Congress sought to prevent included "lobbying programs and partisan political activity" and enabling persons from "outside the government and not answerable to the people or to Congress for their actions" to "assume the functions of directors or indirectly [to] usurp the managerial functions which are the responsibility of the governmental agency."

The federal administrative requirements associated with agency use and management of advisory committees exist to preserve three fundamental principles that must govern the special access to federal decision-makers afforded to advisory committee members: public accountability, transparency, and assurances that advisory committee members serve in the public interest rather than for personal financial gain.

Purpose and Duties of the Task Group

1. The Task Group is performing an independent assessment of NASA's actions to implement the recommendations of the CAIB, as they relate to the safety and operational readiness of STS-114. As necessary to its activities, the Task Group consults with former members of the CAIB.
2. While the Task Group is not attempting to assess the adequacy of the CAIB recommendations, it is reporting on the progress of NASA's response to meet the intent.
3. The Task Group may make other such observations on safety or operational readiness, as it believes appropriate.
4. The Task Group draws on the expertise of its members and other sources to provide its assessment to the Administrator. The Task Group holds meetings and makes site visits as necessary to accomplish its fact-finding. The Task Group has been providing information necessary to perform its advisory functions, including activities of both the Agency and its contractors.
5. The Task Group functions solely as an advisory body and complies fully with the provisions of the FACA.
6. The Task Group will terminate two years from the date of establishment, unless terminated earlier or renewed by the NASA Administrator.

Panels of the Task Group

The RTF TG is comprised of three panels: the Technical Panel, the Management Panel, and the Operations Panel. These are shown in Appendix C.

Technical Panel

The Technical Panel is focusing on NASA's compliance with the CAIB's findings and recommendations in the material condition of the Space Shuttle. This includes technical requirements (development of and compliance with) vehicle engineering, hardware and software development/verification, and overall vehicle certification status involved in the following:

CAIB Recommendations

3.2-1 External Tank (ET) Debris Shedding
3.3-1 Reinforced Carbon-Carbon (RCC) Structural Integrity
3.3-2 Orbiter Hardening
4.2-1 Solid Rocket Booster (SRB) Bolt Catchers
4.2-3 Closeout Inspection
6.4-1 Thermal Protection System (TPS)--Materials – Only

Management Panel

The Management Panel focuses on NASA's compliance with the CAIB's findings and recommendations in Space Shuttle Program (SSP) management, RTF integrated schedule, and program/project risk management involved in:

CAIB Recommendations

6.2-1 Consistency with Resources

6.3-1 Mission Management Team (MMT) Improvements

6.3-2 National Imaging and Mapping Agency (NIMA)/NASA Memorandum of Understanding (MOU)

9.1-1 Implementation Plan and Report to Congress

7.5-1: Independent Technical Engineering Authority

7.5-2: Safety and Mission Assurance Organization

7.5-3: Space Shuttle Integration Office Reorganization

Operations Panel

The Operations Panel focuses on NASA's compliance with the CAIB's findings and recommendations in SSP crew/controller operations and procedures to support operations involved in:

CAIB Recommendations

3.4-1 Ground-based Imagery

3.4-2 Hi-resolution Imagery of ET

3.4-3 Hi-resolution Imagery of Orbiter

4.2-5 Kennedy Space Center (KSC) Foreign Object Damage (FOD)

6.4-1 Thermal Protection System (TPS)--Repairs Only

10.3-1 Orbiter Closeout Photographs

Integration of Assessments

It has been recognized that the CAIB recommendations, particularly the critical recommendations required for RTF, are not independent of one another. In fact, there are several of these that, although distinctly resulting from various findings, have interrelated corrective measures and actions. With this understanding, it was felt to be a priority management initiative to understand these interrelationships in the interest of effective utilization of the human resources, as well as assuring the NASA initiatives undertaken in response to CAIB findings were properly oriented toward meaningful programmatic improvements in the SSP. Appendix H is intended to

graphically show these interdependencies.

Conduct of the Inquiry

For all three panels, review and assessment shall include items the CAIB identifies as mandatory prior to RTF and those issues that may be resolved subsequent to RTF. Review and assessment of planned implementation subsequent to initial RTF may only pertain to NASA's and SSP Office's intent for compliance existing at RTF. The disparate nature of the recommendations requires a unique approach to each evaluation. In general, the lead panel conducts fact-finding by: field trips to appropriate sites; meeting with NASA personnel; discussions with contractors; issuing formal Request for Information (RFI's) to NASA; and consulting with other experts.

Requests for Information

The issuing and closing of RFI's is the formal process of requesting and receiving information from NASA. An RFI could be a simple request for existing facts or a complex inquiry on operations. RFI's can include specific actions by NASA to develop information, such as conducting workshops or making specific presentations. A more complete explanation of the RFI process, including a flowchart and sample forms is included in Appendix G. Appendix E is a list of RFI's issued thus far and their status.

Closure Process

While the panels are pursuing fact-finding activities, NASA is, in most cases preparing detailed plans to implement the CAIB recommendations. These plans are distinguished from the document "NASA's Implementation Plan for Space Shuttle Return to Flight and Beyond" by their level of detail and often include actions indirectly related to, or required as a consequence of implementing the specific CAIB recommendation.

When NASA concludes it has a mature plan, hardware redesign, and requirements documentation changes for implementing a CAIB recommendation, it will present the plan (design changes, etc.) to the appropriate panel(s) of the RTF TG. NASA will also provide to the Task Group an auditable plan/data package which provides their complete and comprehensive strategy for closing out the CAIB recommendation. Each plan/data package should include the following elements:

1. Assumptions and interpretation of CAIB recommendation

2. Description of the actions being taken by NASA (hardware or other products (other than a plan) to provide auditable proof including a list of all requirements documents changes, the test/inspection results and other programmatic documentation requiring updates)

3. Metrics offered as verification of completion

4. Rationale for why NASA believes their actions meet the CAIB expectation(s)

5. Any special direction added in the NASA review/approval authority sequence (RTF Planning Team and SFLC)

6. Authentication signatures:

    a. Office of Primary Responsibility

    b. RTF Planning Team Chair

    c. SFLC Co-Chairs

The RTF TG panel, when it considers the plan mature and the documentation complete, will report to the full RTF TG usually in the presence of the appropriate NASA personnel. Assuming concurrence, the RTF TG will formally notify the SFLC that a suitable plan is in place. However, the RTF TG will not consider the item completed, or "closed-out" until adequate evidence of implementation of the approved plan has been gathered. Therefore, the RTF TG will report separately the status of the "plan" and "implementation." A flowchart of this process is included in Appendix F

Organization of this Report

This report is organized numerically by CAIB recommendation. First, the original language of the CAIB recommendation is provided followed by the RTF TG's interpretation of that recommendation. Next a summary of NASA's plans to address the CAIB recommendation is as stated in the document "NASA's Implementation Plan for Space Shuttle Return to Flight and Beyond" coupled with the RTF TG's assessment of NASA's progress to date. The RTF TG's future plans for completing each evaluation are then overviewed. Finally, a current status is given for:

1. The detailed plan the RTF TG deems necessary for compliance with CAIB
2. The status of the implementation of such a plan;
3. The status of formal RFI's; and
4. The overall status.

Reporting

This interim report was prepared by the Editorial Panel consisting of RADM Walt Cantrell, Dr. Dan Crippen, and Dr. Rosemary O'Leary. The primary substance of the report was provided by the panels. The report was submitted for comments to the entire RTF TG and NASA (for technical comment only). The final version was approved by RTF TG Co-Chair Richard Covey.

CAIB Recommendation 3.2-1 - External Tank (ET) Debris Shedding

Initiate an aggressive program to eliminate all External Tank Thermal Protection System (TPS) debris-shedding at the source with particular emphasis on the region where the bipod struts attach to the External Tank.

RTF TG Interpretation

Eliminate all sources of critical debris by eliminating the bi-pod strut foam and determination of the void size that correlates with a debris size that is acceptable, based on the transport and energy analysis.

NASA Implementation Plan

Initiate three-phase approach to eliminate potential for ET TPS debris loss. Enhance or redesign areas of known critical debris sources including: redesign forward bipod fitting, eliminate ice from the liquid oxygen (LO2) feed line bellows, and eliminate debris from the liquid hydrogen (LH2) intertank flange closeout. Reassess all TPS areas to validate TPS configurations. Pursue comprehensive testing program to understand root cause of foam shedding and develop alternative design solutions to reduce the debris loss potential. Pursue development of TPS Non-Destructive Inspection (NDI) techniques for LO2 and LH2 Protuberance Air Load ramps and LH2 intertank flange manual closeout.

Assessment

The ET Project Office has a three-phase plan to allow for continued improvements in the TPS application and inspection processes.

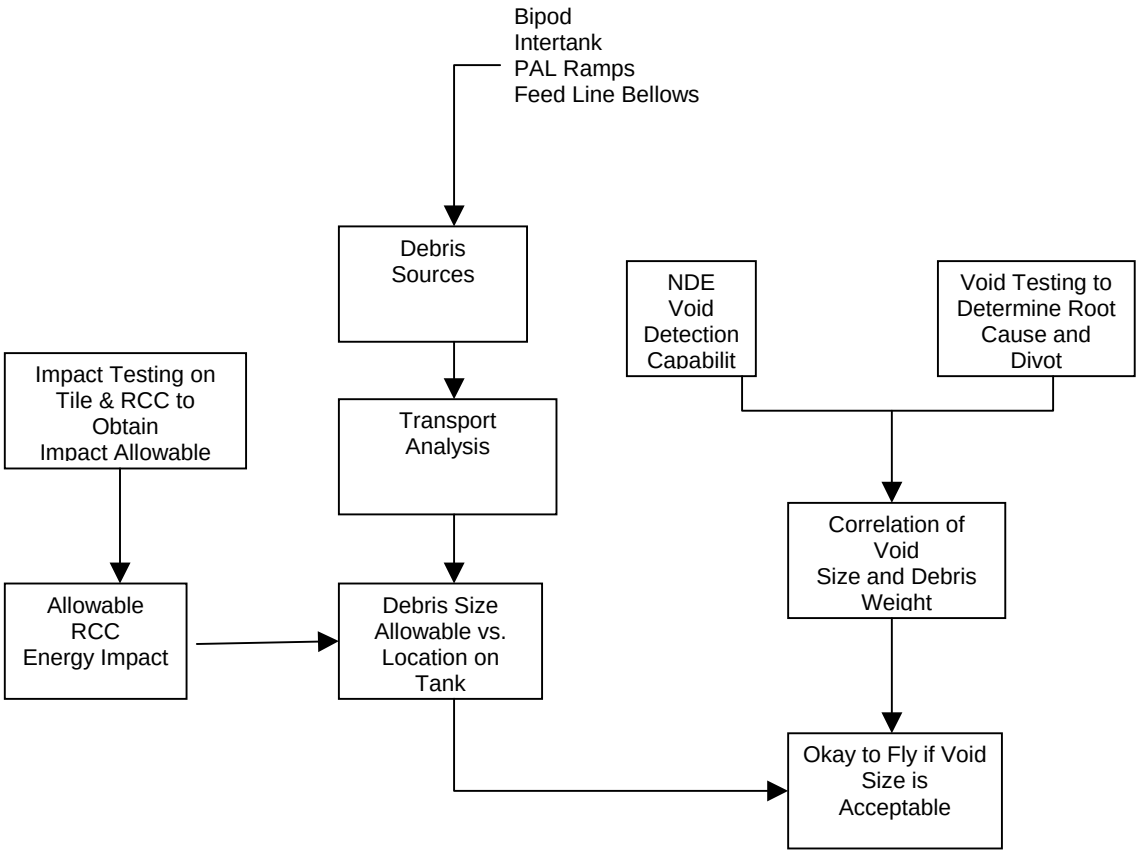
Phase 1: Develop, design, certify and implement the required modification to the ET that will allow for a safe return to flight

Phase 2: Implement additional enhancements to reduce debris risk

Phase 3: Develop, design, certify and implement modifications to the ET that will minimize debris sources in the critical debris zone

The ET Project Office is conducting an integrated systems analysis to assess the critical debris size and flow dynamics. This process is being led by the Systems Engineering and Integration Office (SE&I) within the SSPO. This activity will ultimately lead to the development of a comprehensive model of potential debris flow and risk to critical areas of the Space Shuttle.

An overview plan of tying the debris sources, impact testing, transport analysis, Non-Destructive Evaluation (NDE), and void testing is displayed below.



The Orbiter Project Office is conducting impact tests to obtain allowable energy impacts. The NASA SE&I Office has conducted transport analysis of debris paths from the ET to other elements. These efforts have determined the preliminary debris size allowable as a function of location on the ET. The ET Project Office is also developing an NDE void detection capability, conducting panel and coupon tests to determine root cause of debris loss, and to determine a relationship between void size and debris divot size and then develop a debris weight. These activities are correlated to develop void size and debris weight allowables.

Future

The Technical Panel will continue to review NASA's Implementation Plan and assess the responses to outstanding RFI's. The most critical information remaining to be provided by NASA is documentation of the physics of TPS failure

Status

Plan – Established
Implementation – In Progress
RFI's Outstanding – 3 Open
Overall Status – Open

CAIB Recommendation 3.3-1 – Reinforced Carbon-Carbon Non-Destructive Inspection

Develop and implement a comprehensive inspection plan to determine the structural integrity of all Reinforced Carbon-Carbon system components. This inspection plan should take advantage of advanced non-destructive inspection technology.

RTF TG Interpretation

After a thorough search of the industry and government technologies, select and apply the capability that will give the best results.

NASA Implementation Plan

Pursue inspection capability improvements with newer technologies to allow NDI of RCC without removal. Assess commercially available equipment and develop standards for use on flight hardware. Perform NDI on select Discovery and Atlantis components.

Assessment

NASA has initiated a comprehensive program to determine the structural integrity of all RCC components on Atlantis. To date, the wing leading edge (WLE) panels and T-seals are going through vendor NDE inspection as well as the nose cap and chin panel. This NDE inspection is being performed with techniques originally used to certify the components against original acceptance criteria. The techniques being used are:

- Ultrasonic
- Radiography
- Eddy Current

NASA has identified a three-phase approach for implementing the CAIB recommendation. Phase 1 is focused on return to flight, which the Technical Panel is reviewing; however, Phase 2 is being evaluated and commented on by the Technical Panel.

After components are NDE inspected at the vendor and shipped to KSC, an additional NDE technique, thermography, is being used to establish a baseline and compare to original NDE acceptance criteria. NASA's plan is to correlate the thermography data to the vendor NDE data.

Thermography is one of five techniques identified by a panel of outside experts as potentially being applicable to Orbiter inspections. Of these five techniques, flash thermography and ultrasound show the greatest promise for on-vehicle inspection. The efforts underway by NASA seek to take advantage of the original vendor NDE inspection techniques coupled with the new techniques for correlation and potential validation. NASA currently expects the Atlantis RCC inspection assessments to be presented for closeout by early 2004 with recommended advanced on-vehicle inspection techniques to be matured by late 2004.

NASA has demonstrated, through an active destructive coupon test program of flown RCC

samples that no new aging issues exist with the RCC components. These samples are tested to determine if the strength meets technical standards. These tests have shown that there is no unexpected loss of strength of the RCC due to aging. In fact, the RCC is performing well within the expectations.

Future

The Technical Panel will continue to monitor progress and additional activities associated with this recommendation**.** NASA will have a record of the condition of the RCC on the first flight hardware as established by NDE methods.

Status

Plan – Preliminary, pending final selection of NDE methods
Implementation – In Progress
Outstanding RFI's – None
Overall Status – Open

CAIB Recommendation 3.3-2 – Orbiter Hardening

Initiate a program designed to increase the Orbiter's ability to sustain minor debris damage by measures such as improved impact-resistant Reinforced Carbon-Carbon and acreage tiles. This program should determine the actual impact resistance of current materials and the effect of likely debris strikes.

RTF TG Interpretation

For the first Orbiter returning to flight, the actual impact resistance of installed material will be known. Any other hardening that can be accomplished without major change should also be accomplished.

NASA Implementation Plan

Define candidate redesigns that will reduce impact damage risk to vulnerable TPS areas. Develop forward-looking assessment plan for TPS/Wing Leading Edge (WLE) enhancement redesign options. Establish plan to determine impact resistance of RCC and tiles including: identify debris sources, provide transport analyses of debris sources, and conduct test program to determine impact resistance of RCC and tile.

Assessment

NASA has prioritized a list of candidates for the long-term enhancement (i.e., hardening) of TPS. The prioritized candidates are:

- WLE Redesign
- Durable Tile
- Landing Gear Door and ET Door Redesign
- Carrier Panel Upgrades to eliminate Bonded Studs
- TPS Instrumentation
- White Toughened Unipiece Fibrous Insulation
- Vertical Tail Advanced Flexible Reusable Surface Insulation High-Emittance Coating
- Robust RCC Replacement Study

The Technical Panel has conducted fact-finding sessions and received briefings on the first five items listed above. Once again, NASA has a three-phase approach for this recommendation. For Phase 1, return to flight activities, NASA's progress has been in the areas of the Main Landing Gear Door (MLGD) and Forward Reaction Control System (FRCS) Carrier Panel Redesign. The MLGD area is focused on the elimination of corner voids to eliminate potential flow paths. The redesign effort for return to flight is concentrating on filling the voids with TPS soft goods. The FRCS Carrier Panel Redesign is focused on the redesign of the carrier panel attachments to eliminate bonded studs. This redesign will eliminate the concern that the carrier panel installation has negative margin if a bonded stud is lost due to debris impact. Also for Phase 1 return to flight, WLE instrumentation that would allow potential detection of impacts is being planned.

This instrumentation is based on previously flown hardware and is being reconfigured as a demonstration for the next flight (not a constraint for RTF).

Phase 2 of this effort is planned to be a redesign of the MLGD to provide a redundant thermal barrier. A significant test program is underway to determine debris impact allowables. This item will support redesign activities and on-orbit inspection capabilities. Phase 3 will focus on the remainder of the items identified.

Future

The Technical Panel will continue to monitor progress and additional activities associated with this recommendation. NASA's test program for determination of impact resistance should be completed before return to flight.

Status

Plan – Preliminary, subject to test results
Implementation – In Progress
Outstanding RFI's – None
Overall Status – Open

CAIB Recommendation 3.4-1 – Ground-Based Imagery

Upgrade the imaging system to be capable of providing a minimum of three useful views of the Space Shuttle from liftoff to at least Solid Rocket Booster separation, along any expected ascent azimuth. The operational status of these assets should be included in the Launch Commit Criteria for future launches. Consider using ships or aircraft to provide additional views of the Shuttle during ascent.

RTF TG Interpretation

The CAIB image analysis was hampered by the lack of high-resolution and high-speed ground-based cameras. The existing camera locations were a legacy of earlier NASA programs, and were not optimum for the exit trajectory of Space Shuttle missions. Further, often cameras were not operating or were out of focus (as was the case for the Columbia launch). The CAIB was concerned about the need to have an adequate number of ground cameras, located and operating properly, to provide photographic coverage from more than one view of the Space Shuttle during the launch trajectory through separation of the SRB. Supporting this, the CAIB made the following finding:

F3.4-4 *The current long-range camera assets on the Kennedy Space Center and the Eastern Range do not provide best possible engineering data during Space Shuttle ascents.*

NASA Implementation Plan

NASA has formulated a plan to address the issues/recommendation of the CAIB. This effort will lead to significant additional locations of cameras to cover, from different viewing angles, all phases of the Space Shuttle ascent trajectory. A Marshall Space Flight Center (MSFC) computer program has been used to simulate the view that will be obtained from each camera site to permit coverage evaluation of camera locations. The camera equipment is being refurbished/upgraded as appropriate to improve reliability. High Definition Television is being added to the ground locations. The use of airborne cameras aboard a NASA B-57 aircraft is being explored. The Air Force has corrected the out of focus problem encountered on one of the range cameras during the Columbia launch. The criteria/process for evaluating and reporting camera operational status during the Launch Commit phase of the launch process is in the planning phase. The criteria/processes for evaluating the impact of weather on camera coverage of the ascent trajectory are also in development and should be available for review in early spring 2004.

Assessment

Members of the RTF TG Operations Panel have had a series of several fact-finding meetings with KSC and Air Force personnel (including the appropriate contractor personnel) to review the plans for addressing the recommendation. The Program Requirements Control Board actions regarding recommendations have also been reviewed. The panel concludes that NASA is making solid progress toward fulfilling this CAIB recommendation.

Future

The RTF TG will review the Program Requirements Documents which will contain the minimum launch camera coverage, the plans for assuring operational status of the ground-based cameras, and the Launch Commit criteria to include the weather constraints when the plans are finalized. The RTF TG has submitted an RFI to NASA inquiring whether the new camera arrangement will be pre-tested on a non-Shuttle launch. To date, this RFI has not been answered.

Current Status

Plan – In Progress
Implementation – In Progress
Outstanding RFI's – 3 Open
Overall Status – Open

CAIB Recommendation 3.4-2 – High-Resolution Images of External Tank (ET)

Provide a capability to obtain and downlink high-resolution images of the External Tank after it separates.

RTF TG Interpretation

Engineering quality imagery of the ET taken from Columbia would have been of great significance in the Columbia investigations. Columbia carried the standard on-board film still camera installed in the umbilical well that provides images of the ET following separation from the Orbiter. The camera provides images of sufficient quality/resolution to permit an engineering evaluation of the performance of the ET Thermal Protection System (TPS) to include foam shedding. Additionally, following ET separation, the Orbiter is maneuvered into a position that permits a crew member to take images, using a hand-held film still camera, of the ET which also provides data regarding foam shedding. Following landing, the film from the umbilical well and hand-held crew cameras is removed and developed for evaluation. Neither of these two cameras was recovered from the Columbia debris. The CAIB investigators believed the images from these two cameras would have provided valuable engineering information and would have helped in determining the cause of the accident. This triggered the following finding:

F3.4-3 *There is a requirement to obtain and downlink on-board engineering quality imaging from the Shuttle during launch and ascent.*

NASA Implementation Plan

Selection of the appropriate digital still cameras for the umbilical well and the crew has been completed and the hardware is undergoing flight qualification. The engineering for the installation of the umbilical well camera is underway. Every effort is being made to have the umbilical well camera installed and operational for the next flight. The crew hand-held digital camera will be available for the next mission. The images from both the umbilical well and crew cameras will be electronically retrieved and down linked for evaluation following orbit insertion.

Assessment

The RTF TG Operations Panel received outlines and presentations of the response to the recommendations on two occasions from the SSP staff. It is clear that the view of the ET from the crew camera is dependent upon the relative position of the ET and the Orbiter, as well as the sun lighting on the ET. Thus, the desired ET coverage is not assured. The views from the umbilical well camera cover the areas of interest on the ET and provide reliable data to permit evaluation of the ET TPS. Therefore, every effort should be made to have the umbilical well camera installed and operational for the next flight.

Future

The Operations Panel will continue to follow the progress of the qualification and installation activities concerning these two cameras.

Current Status

Plan – In Progress
Implementation – In Progress
Outstanding RFI's - None
Overall Status – Open

CAIB Recommendation 3.4-3 – High-Resolution Images of Orbiter

Provide a capability to obtain and downlink high-resolution images of the underside of the Orbiter wing leading edge and forward section of both wings' Thermal Protection System.

RTF Interpretation

The CAIB investigations of the Columbia accident were hampered by the lack of high-resolution images of the launch ascent trajectory. The only images available were from ground cameras that were inadequate in number, placement, and resolution to permit a meaningful and timely engineering analysis of the ET Thermal Protection System (TPS) performance. Accordingly, the CAIB made the following findings:

F3.4-3 *There is a requirement to obtain and downlink on-board engineering quality imaging from the Shuttle during launch and ascent.*

F3.4-4 *The current long-range camera assets on the Kennedy Space Center and Eastern Range do not provide best possible engineering data during Space Shuttle ascents.*

F3.4-5 *Evaluation of STS-107 debris impact was hampered by lack of high resolution, high speed cameras (temporal and spatial imagery data).*

NASA Implementation Plan

Cameras will be installed on the ET (inside the feed line fairing) and the SRB's to provide coverage of the both Wing Leading Edges (WLEs) and forward sections. Computer-generated simulations of the coverage from various locations were used to select the best locations for camera placement. The ET camera equipment has been selected and qualification testing is in progress. Images from the camera will be transmitted to ground receiving stations during the ascent. The ET camera is planned to be operational for the next flight.

Cameras for installation on the ET attach ring, SRB forward skirt and SRB modified forward skirt have been selected and are undergoing qualification testing. NASA has a phased approach for this implementation. For STS-114, NASA has implemented the ET Liquid Oxygen (LOX) fairing camera looking aft toward the right side of the Orbiter, plus two SRB cameras looking sideways into the ET Intertank. The SRB External Tank Attachment (ETA) ring camera is scheduled for implementation next (the goal is for STS-121). The SRB nose cameras looking aft toward the Orbiter wing leading edges will be implemented after that (the goal is for STS-115). Current NASA launch dates are: 1) STS-114 No Earlier Than 12 September 2004, 2) STS-121 No Earlier Than 15 November 2004, and 3) STS-115 No Earlier Than 10 February 2005. All SRB-mounted cameras will record and store the images. The cameras with the stored images will be removed from the SRB's following their recovery from the ocean.

In the final configuration, there will be one camera installed on the ET that will provide real-time imagery and three cameras mounted on each SRB.

Assessment

The RTF TG Operations Panel members reviewed the response of the SSP Office to the recommendation cited above. The panel concludes that NASA is making solid progress toward fulfilling this CAIB recommendation.

Future

The Operations Panel members will continue to monitor the progress of the qualification and installation activities of the additional cameras.

Current Status

Plan – In Progress
Implementation – In Progress
Outstanding RFI's - None
Overall Status – Open

CAIB Recommendation 4.2-1 – Solid Rocket Booster Bolt-Catcher

Test and qualify the flight hardware bolt catchers.

RTF TG Interpretation

Meaning of the CAIB recommendation is clear.

NASA Implementation Plan

Design and qualify by testing as a complete system. Fabricate housing from single piece of aluminum (AL) with no weld. Select new energy-absorbing material. Reassess thermal protection material. Redesign and resize ET attachment bolts and inserts.

Assessment

The bolt catcher for the SRB to ET separation bolt has been modified to correct the initial design which did not demonstrate an adequate safety factor. The original design was a two-piece welded assembly and the new design is based on a one-piece forging. The energy absorber used to attenuate the bolt impact load has been redesigned as well. Additionally, the TPS has been changed from sprayed-on TPS to bonded cork. The NASA Standard Initiator (NSI) in the pressure cartridge had exhibited an ejection failure mode during several tests. This can result in damage to the energy absorber prior to bolt impact. This issue has been addressed by the incorporation of a locking ring assembly to aid in retention of the NSI.

The Critical Design Review (CDR) for the modified assembly was held during the month of November 2003. The next CDR, originally scheduled for December 17, has been postponed until the outstanding Review Item Discrepancies are resolved.

The Technical Panel is in general agreement with the approach being taken to redesign the SRB/ET bolt catcher and the associated NSI retaining ring. The proposed design incorporates significant improvements over the previous design. Testing and analysis indicates that the resultant design will have a structural safety factor of at least 1.4 with margin. Testing to be performed will include maximum ejection velocities for the separation bolt and combined environments testing for the bolt catcher assembly. Design work is in progress with regard to the load limits, design velocities, combined environments testing, and inspection and acceptance criteria.

Future

The Technical Panel will monitor the tests of the redesigned hardware.

Status

Plan – Complete
Implementation – Good Progress
Outstanding RFI's – 1 Open
Overall Status – Open

CAIB Recommendation 4.2-3 – Closeout Inspection

Require that at least two employees attend all final closeouts and intertank area hand-spraying procedures.

RTF TG Interpretation

The Technical Panel and NASA have approached this recommendation as though it intended that the two-person process should cover all intertank hand-spraying procedures and all ET closeout processes. Subsequent conversations with CAIB members indicate that the intent of this recommendation is to apply to all Shuttle closeouts.

NASA Implementation Plan

TPS Verification Team to develop minimum requirements for foam processing. Enhance TPS parameters and requirements. Add requirements for observation and documentation of processes. Review and update process controls. Two employees to attend all final closeouts and critical hand-spraying procedures.

Assessment

The Michoud Assembly Facility has presented a plan to the Technical Panel to update all Manufacturing Process Procedures (MPP) associated with the ET to include this recommendation. The Technical Panel will receive and verify these MPP's after completion.

Future

The Technical Panel will continue to clarify the meaning of this recommendation and to monitor progress and additional activities associated with this recommendation. NASA will provide to the Panel the MPP's and Test Plans that establish these processes.

Status

Plan – Broad plan issues. Specific plans not prepared.
Implementation – In Progress
Outstanding RFI's - None
Overall Status – Open

CAIB Recommendation 4.2-5 – Kennedy Space Center Foreign Object Debris

Kennedy Space Center Quality Assurance and United Space Alliance must return to straightforward, industry-standard definition of 'Foreign Object Debris' and eliminate any alternate or statistically deceptive definitions like "processing debris."

RTF TG Interpretation

During their investigation and interviews with personnel involved with processing the Space Shuttle for flight, the CAIB determined that NASA, in 2001, generated new and non- standard definitions for FOD. The term "processing debris" was applied to debris found during the routine processing of the flight hardware. The term FOD applied only to debris found in flight hardware after final closeout inspections. These definitions were unique to the SSP at KSC. Because debris of any kind has critical safety implications, these definitions are important. Accordingly, the CAIB wanted the standard, industry-wide definitions re-established for FOD. In support of this conclusion, the CAIB made the following finding:

F4.2-18 *Since 2001, Kennedy Space Center has used a non-standard approach to define foreign object debris. The industry standard term "Foreign Object Damage" has been divided into two categories, one of which is much more permissive.*

NASA Implementation Plan

KSC will adopt the FOD definition derived by National Aerospace FOD Prevention, Inc (a non-profit educational organization recognized within industry as the authority for FOD matters) and will change the operational procedures accordingly. In order to identify where and when FOD was discovered, so that appropriate correction action can be taken, FOD will be noted as found: 1) at end of shift, 2) at closeout, or 3) in process. FOD is defined as unaccompanied foreign material. The revised definition will not alter the current policy of "clean as you go" but will result in more emphasis on the procedure of cleaning up the work area as the work progresses rather than cleaning the work after the work is completed. A joint KSC and United Space Alliance (USA) team visited Air Force aircraft modification centers, a Grumman Aerospace Facility, and the Gulf Stream aircraft factory to study how the FOD issue was addressed by those organizations. Lessons learned will be incorporated into the KSC procedures/processes. A major education effort regarding the revised definition will be undertaken at the appropriate time to make sure the definitions and the accompanying rationale are understood by the entire KSC (NASA) and USA work force.

Assessment

RTF TG Operations Panel members met with KSC Quality Assurance and USA personnel to review their planned response to the CAIB finding and recommendation on FOD. It was learned that the intent of KSC in changing the definitions in 2001 was to establish a database that would allow management to identify when the FOD was being generated during the processing flow so that appropriate action could be taken to correct the problem. The work force was neither adequately informed nor educated on the reason for the new definition and a misunderstanding resulted. The panel believes that NASA is making solid progress toward meeting this CAIB recommendation.

Future

The RTF TG Operations Panel members will review the implementation of the KSC plan outlined above upon receipt.

Current Status

Plan – Complete
Implementation – In Progress
Outstanding RFI's - None
Overall Status – Open

CAIB Recommendation 6.2-1 – Consistency with Resources

Adopt and maintain a Shuttle flight schedule that is consistent with available resources. Although schedule deadlines are an important management tool, those deadlines must be regularly evaluated to ensure that any additional risk incurred to meet the schedule is recognized, understood, and acceptable.

RTF TG Interpretation

The CAIB explicitly recognized the legitimacy of the use of schedules to drive a process. They were concerned, however, when the line between "beneficial" schedule pressures and those that become detrimental cannot be defined or measured. The CAIB further observed that budget constraints inherently intensify the conflicts between schedule and safety.

NASA Implementation Plan

Among the activities NASA plans to undertake are: more routinely assessing schedule risk (to minimize surprises), incorporating more margin into the schedule and manifest to accommodate changes, potentially adopting some of the risk management tools used for the Space Station, and revising databases so schedule and risk indicators can be assessed real-time by managers.

Assessment

The Task Group fully recognizes the need for schedules to manage the extremely complex operation of preparing, loading, and launching a space vehicle. However, at some indefinable juncture, schedule pressure can become a destructive force or become the primary objective. This appears to have been a chronic problem for NASA in general and the Shuttle Program in particular for decades.

NASA and its contractors are developing more sophisticated tools for assessing schedule risk and manifest constraints. At least some components of these tools will be available to prepare for the next launch.

The Management Panel of the Task Group has conducted interviews to confirm many of the CAIB observations; e.g., that the schedule established for the Space Station was the schedule constraint more than any other factor in recent launches. Further, the Management Panel has begun to assess the budget process both within and without NASA with an eye toward potentially detrimental incentives or practices.

Future

The Management Panel have issued several RFI's to NASA on these issues, to include: (1) the potential for benchmarking risk assessment and schedule management techniques against other agencies and organizations; (2) what human resources, including training, are necessary to implement the planned expansion of risk assessment; and (3) how new organizational elements, such as the SSP Office Program Risk Advisory Board will integrate with existing processes and

practices. The Management Panel will be looking for continuing development of appropriate risk-management tools and processes to help mitigate against schedule pressure from building to the point of jeopardizing safety.

Continuing validation of the implementation of this recommendation will require scrutiny by the Aerospace Safety Advisory Panel or some other qualified, independent group well beyond the next launch.

Current Status

Plan – In Development
Implementation – In Progress
Outstanding RFI's – 1 Open
Overall Status – Open

CAIB Recommendation 6.3-1 – Mission Management Team Improvements

Implement an expanded training program in which the Mission Management Team faces potential crew and vehicle safety contingencies beyond launch and ascent. These contingencies should involve potential loss of Shuttle or crew, contain numerous uncertainties and unknowns, and require the Mission Management Team to assemble and interact with support organizations across NASA/Contractor lines and in various locations.

RTF TG Interpretation

MMT activities during the flight of Columbia have been widely criticized. Many of the additional capabilities embedded in other CAIB recommendations, such as imagery from various sources, are intended to support MMT activities for the next and subsequent flights. In addition to enhanced training for participants in the MMT, NASA will need to exercise these many new sources of data and information.

NASA Implementation Plan

The first action by NASA was to form a team in June 2003 to address the recommendation. The team focused on revising MMT guidance and organizational issues to make more formal all MMT proceedings and meetings. In addition, the new organization is to "strengthen" the process for receiving and reviewing dissenting views concerning safety, operations and engineering, and to expand the process of evaluation of problems that arise after a Space Shuttle is launched. An integral part of the corrective actions is the development of a training approach that focused on both individual and team effectiveness. The plan will include classroom sessions, individual study of recommended literature, and group dynamics training in the form of simulations involving the convening of the MMT. A long-term plan is scheduled to be published in January 2004.

Assessment

The Management Panel of the Task Group has reviewed the previous MMT organization and processes. The panel has received several SSP presentations on the plans for MMT organizational and operational changes. Further, representatives of the panel have observed two simulations of the MMT as it exercised parts of its new configuration, including one simulation involving joint operation with the International Space Station and attended one MMT training session in "Normal Accident Theory." Finally, the Panel has issued a number of requests for further information which are largely outstanding.

NASA SSP briefed the Management Panel on December 9 on a possible closeout of the CAIB 6.3-1 recommendation. While the Management Panel found that NASA has made progress in responding to this recommendation, the Panel felt it was far too premature to recommend closure to the full RTF TG and will await the final MMT Training Plan, more specific plans for future simulations (and the objectives to be tested and evaluated), full demonstration for the rationale to closeout (to include NASA's assessment of how the MMT training plan meets specific CAIB criticisms), and the response to various outstanding RFI's. Ultimately, to validate implementation, the Management Panel will need to witness additional MMT simulations, assess how the MMT

and Mission Evaluation Room (MER) are responding to "lessons learned" from prior simulations and new procedures, observe how each MMT member is fulfilling their newly assigned role and responsibilities (per revisions to NSTS 07700, Vol. VIII, Appendix D), assess how information feeds into the MMT, and assess how the MMT addresses risk management and ongoing communications issues.

Future

Much of what the Task Group hopes to witness in NASA's response to this recommendation (as well as 6.3.2) should be directly observable through the simulations developed and exercised to "practice" the MMT. These simulations must be very robust, and include test and validation of NASA actions taken on other CAIB RTF recommendations (as appropriate); demonstrate a rigorous process for review and disposition of mission anomalies and issues; demonstrate and validate revised MMT procedures and member responsibilities; and as thoroughly as possible, incorporate all assets available to NASA utilized under realistic conditions. Creativity on identifying and resolving bottlenecks and testing processes must be encouraged. Seamless connection between the MMT and the International Space Station MMT (or IMMT) is also critical when the Space Station is involved.

Some of the things the Management and Operations Panels will look for include: quality and adequacy of the training plan (due in January 2004); clarity and adequacy of revised MMT procedures and member responsibilities; thorough exercise of all NIMA assets (see next recommendation); the appropriate mingling (including storage) and analysis incorporating both classified and non-classified data; a demonstrated ability to integrate all sensor and imagery data; an exercise of the crew contingency option Contingency Shuttle Crew Support; observation of how the MMT will integrate the new Independent Technical Engineering Authority (ITEA), SE&I Office, and S&MA roles and responsibilities as recommended in the CAIB report recommendations 7.5-1, 7.5-2, and 7.5-3; a thorough exercise of the Still Images Management System (SIMS) database; and, timely access to engineering drawings and the new digital photos of closeout. The MMT's ability to respond to lessons-learned from the simulations also needs to be demonstrated as well as the effect and impact of the revised MMT processes and procedures on decision-making and the process for ensuring sustainability of MMT corrective actions over time.

Some of these capabilities, just like those involving repair, could be tested with unmanned launches before the next Space Shuttle flight and during the next flight as well.

Current Status

Plan – Awaiting more detail and full documentation.
Implementation – Will occur with simulations over next months.
Outstanding RFI's – 3 Open
Overall Status – Open

CAIB Recommendation 6.3-2 – National Imagery and Mapping Agency Memorandum of Agreement

Modify the Memorandum of Agreement with the National Imagery and Mapping Agency to make the imaging of each Shuttle flight while on orbit a standard requirement.

RTF TG Interpretation

There was considerable public discussion of the decision during the flight of the Columbia to forego requesting the assistance of other federal agencies in assessing the condition of the Space Shuttle. In addition to changes in the MMT discussed above, the CAIB wanted the SSP to have the procedures in place to get all possible data to investigate a potential problem.

NASA Implementation Plan

Per agreement with other federal agencies, NASA is seeking all available data that may in the future assist in the resolution of investigations. Plans for all required activities, communications, personnel security access, training, physical receipt and proper storage of classified material, hardware and software to analyze the data are being worked consistent with the return to flight schedule. Capability is to be demonstrated in various stages during simulations this winter and spring and will culminate in a capability demonstration during an MMT simulation in July. Portions of these support functions can be simulated well before the detailed procedures and data flow capabilities are put in place.

An engineering test of equipment is scheduled for March 2004, including an end-to-end system simulation involving participating personnel. With the help of the Office of Personnel Management, clearance paperwork has been initiated for 106 people (approximately 85% government and 15% contractor). It is anticipated that 50% of the clearances will be in place by the March 2004 simulation.

Final implementation details are being worked out in a lower level MOU.

Assessment

Members have been actively engaged in this assessment. A revised MOU between NIMA and NASA has been signed. A detailed lower-level MOU is in work to implement the details. All required activities: communication, personnel security access training, physical receipt and storage of classified material, hardware and software to analyze the data and detailed simulations are on track to support the return to flight effort. Successful implementation this spring will verify this capability.

Future

The Management Panel has a number of additional activities for NASA to undertake, most of them mentioned above in the context of simulations and exercise of the MMT. It is worth repeating that the Task Group expects a full incorporation of the operation of the MOU, including

the receipt of actual data, the incorporation and distribution of classified and non-classified information, and the development and use of the necessary storage and archiving capabilities. The Management Panel will further encourage NASA to include an exercise and test of this entire process during the next Space Shuttle flight.

Current Status

Plan – Largely Complete
Implementation – Underway, but MMT simulations necessary.
Outstanding RFI's – 1 Open
Overall Status – Open

CAIB Recommendation 6.4-1 – Thermal Protection System Inspection and Repair

For missions to the International Space Station, develop a practicable capability to inspect and effect emergency repairs to the widest possible range of damage to the Thermal Protection System, including both tile and Reinforced Carbon-Carbon, taking advantage of the additional capabilities available when near to or docked at the International Space Station.

For non-Station missions, develop a comprehensive autonomous (independent of Station) inspection and repair capability to cover the widest possible range of damage scenarios.

Accomplish an on-orbit Thermal Protection System inspection, using appropriate assets and capabilities, early in all missions.

The ultimate objective should be a fully autonomous capability for all missions to address the possibility that an International Space Station mission fails to achieve the correct orbit, fails to dock successfully, or is damaged during or after undocking.

RTF TG Interpretation

The intent of the CAIB is clear.

NASA Implementation Plan

Define damage thresholds below which no repair is required as well as thresholds above which repair is deemed unfeasible. Develop the capability to resolve critical TPS damage in all areas. In long-term, develop a sensor capable of 3-D damage measurement. Investigate use of optical filters to highlight low-contrast damage. Implement comprehensive in-flight inspection, imagery analysis, and damage assessment strategy through existing planning process. Investigate the use of impact sensors to limit the need for extensive in-flight inspection of the wing leading edge. Develop repair procedure for Extravehicular Activity (EVA) access while docked to the International Space Station (ISS). In the long-term, develop standalone 3-D detection of tile and RCC damage, as well as an EVA repair capability independent of the ISS. Develop EVA tool and repair techniques. Baseline and complete analysis for docked repair technique.

Assessment

This recommendation is led by the Technical Panel with support by the Operations Panel. For return to flight, NASA plans to perform inspections via the ISS and demonstrate concepts for inspections and repair. For the next flight, full inspection of the TPS will be accomplished using the ISS as support. This effort is transitioning from feasibility assessment to preliminary design. Design and simulations are underway for autonomous inspection (separate from ISS) utilizing a boom extension to the Shuttle Remote Manipulator System. RTF TG Operations Panel members convened at the Johnson Space Center (JSC) for a status briefing in September and to receive a demonstration of the preliminary work on this CAIB recommendation. The demonstration included: the preliminary efforts in ascertaining what NASA considers “critical damage,” early strategies for inspecting the TPS, both from the ISS as well as in a standalone mode, several

candidates for tile repair material and tools to apply material, and the early strategies for repairing the RCC. The demonstrations served both as an introduction to the problem as well as the process by which materials and methods are being down selected for use. The near-term plan is to use the ISS in a support mode for both inspection and repair. The long-term objective is to provide a fully autonomous TPS inspection and repair capability for all Space Shuttle missions.

Repair material development for both tile and RCC are proceeding. Tile repair material development is significantly ahead of RCC due to extensive work done early in the Shuttle Program (1980s). Two materials are being evaluated and tested with a "down select" planned by the end of 2003. Three RCC repair concepts have been identified and are being evaluated. A test program for the concepts has been briefed to the Task Group and both the Operations and Technical Panel will follow the progress.

Future

The Technical and Operations Panels will continue to monitor progress and additional activities associated with this recommendation.

Status

Plan – Preliminary issued pending test results
Implementation – In Progress
Outstanding RFI's – 3 Open
Overall Status – Open

CAIB Recommendation 7.5-1 – Independent Technical Engineering Authority

Establish an Independent Technical Engineering Authority that is responsible for technical requirements and all waivers to them, and will build a disciplined, systematic approach to identifying, analyzing, and controlling hazards throughout the life cycle of the Shuttle System. The independent technical authority does the following as a minimum:

- *Develop and maintain technical standards for all Space Shuttle Program projects and elements*
- *Be the sole waiver-granting authority for all technical standards*
- *Conduct trend and risk analysis at the sub-system, system, and enterprise levels*
- *Own the failure mode, effects analysis and hazard reporting*
- *Conduct integrated hazard analysis*
- *Decide what is and is not an anomalous event*
- *Independently verify launch readiness*
- *Approve the provisions of the recertification program called for in Recommendation R9.1-1*

The Technical Engineering Authority should be funded directly from NASA Headquarters, and should have no connection to or responsibility for schedule or program cost.

RTF TG Interpretation

Many of the CAIB's SSP organization observations are reflected in this recommendation. They observed, for example, a program "requirement" that no foam be dislodged from the ET was somewhat routinely waived for Columbia's last launch. They concluded that the inherent conflicts of schedule, cost, and safety—the balance for which resided essentially with the Shuttle Program Manager—need to be separated.

It should be noted that while this recommendation (R7.5-1) requires the establishment of the ITEA, the CAIB has not identified it as an RTF requirements. R9.1-1, which is discussed later, is an RTF requirement but only for the creation of a detailed plan for defining, establishing, transitioning, and implementing an ITEA. In discussion with the TF TG, the CAIB Chair (Admiral Gehman) stated that this position was taken with the understanding that full implementation of R7.5-1 (as well as R7.5-2 and R7.5-3) would require a considerable time to reach full implementation and prior to RTF, existence of a well-defined plan would suffice,. The TF TG is awaiting NASA position on this matter of implementation.

NASA Implementation Plan

NASA's leadership has been grappling with its response to this recommendation precisely because of the risk of separating these responsibilities—the establishment of requirements and

waivers thereto and responsibility for risk analysis—from the SSP creates the risk of divorcing responsibility from accountability.

Thus far, NASA has determined that the Headquarters Office of Safety and Mission Assurance (S&MA) will be responsible for developing a plan for an Independent Technical and Engineering Authority (ITEA). It is likely the ITEA will be funded through the S&MA and report to the director of that office. NASA intends to include a clear statement of responsibility (and presumably accountability) for cost, schedule, and technical issues. NASA has advised the TF TG (Management Panel) that the NASA Administrator has directed the implementation of this recommendation to be applied across-the-board to all NASA activities. This broadened scope has required increased coordination throughout NASA by S&MA in attempting to arrive at a suitable resolution.

Assessment

The Management Panel has spent considerable time analyzing the consequences of this recommendation in anticipation of receiving a proposed plan from NASA. The Management Panel has received several presentations on the Navy submarine systems and the Navy's nuclear propulsion program and their differences with NASA. The Panel has heard from management experts familiar with NASA on the desirability of strict implementation of this recommendation. And the Panel has had interim reports from the Office of S&MA, most recently at meetings in early December. The Management Panel has a number of RFI's outstanding, the response to which awaits some initial decisions by NASA on the design of the ITEA.

Future

The Management Panel will be, particularly with regard to this recommendation, looking as much for the (unintended) consequences of its implementation as it will the strict compliance with the recommendation

Status

Plan – In Development
Implementation – N/A
Outstanding RFI's – 2 Open
Overall Status – Open

CAIB Recommendation 7.5-2 – Safety and Mission Assurance Organization

NASA Headquarters Office of Safety and Mission Assurance should have direct line authority over the entire Space Shuttle Program safety organization and should be independently resourced.

RTF TG Interpretation

The CAIB observed that various parts of NASA were nominally responsible for "safety;" each NASA center has safety organizations; each NASA program, including the SSP, has designated individuals responsible for safety; and, NASA has an Office of S&MA at its Headquarters. This recommendation is intended to create clear lines of responsibility and communication and help ensure independence by moving funding from the NASA centers and programs to Headquarters.

NASA Implementation Plan

NASA has responded, in the first instance, by essentially proposing to implement the letter of the recommendation. They have gone further by creating a new entity deemed the NASA Engineering and Safety Center (NESC) at Langley Research Center to "…provide independent engineering and safety assessment." This effort will be funded from Headquarters through the Office of S&MA with "policy guidance" from that Office.

The notional intention of the NESC is to provide a center for excellence—in this case excellence in engineering—that have been established in many other scientific endeavors. Among its responsibilities are the "independent testing" of analytical models and their assumptions and incorporate safety and engineering trend analysis. Its personnel are to come from within NASA and are presumed to serve on a rotating basis. It is intended that these temporary assignments will be viewed within the organization as a positive step in career development and advancement.

Assessment

The Management Panel has received briefings on the new organization and discussed with NASA the implementation of this center. Although the NESC is underway and has started to issue reports, there are several important questions outstanding and critical observations to be made throughout next year. The Management Panel has issued several RFI's from NASA (and more are likely).

Future

Some of the issues the Panel expects to see incorporated in NASA's planning include: the detail of personnel rotations; the effect of personnel rotation on the capabilities across NASA; personnel policies to augment and enhance rotation; the process for selection of issues; the origination of issues (within NESC or without); the authority and impact of NESC on risk analysis and decision-making; and, the role of NESC in mission management.

The Management Panel will also be observing the implementation of the reorganized safety function. The Panel will want to: (1) observe the interface of the "independent" safety and

mission assurance with the SSP; (2) the levels and source(s) of funding for the various safety enterprises; (3) the expertise of the personnel in the various safety components; (4) the role of the Office of S&MA in launch preparation and certification; and (5) the clarity of the accountability for safety.

Status

Plan – Missing Critical Elements
Implementation – Underway, but incomplete.
Outstanding RFI's – 1 Open
Overall Status – Open

CAIB Recommendation 7.5-3 – Space Shuttle Integration Office Reorganization

Reorganize the Space Shuttle Integration Office to make it capable of integrating all elements of the Space Shuttle Program, including the Orbiter.

RTF TG Interpretation

During the 1990's as NASA budgets were squeezed, the Space Shuttle was thought to be in a "going out of business" mode. The Space Shuttles were being successfully flown and the Space Shuttle operations were increasingly out-sourced with NASA's systems engineering capabilities being greatly diminished.

The CAIB found several aspects of Space Shuttle operations that they believed suffered from incomplete integration. Perhaps the most glaring was the apparent division of responsibility for addressing the separation of foam from the ET. Simplistically stated, the Orbiter Program thought it was up to the tank folks to stop the shedding and the Tank Program assumed that the little shedding that was occurring was not injurious to the Space Shuttle because no one told them otherwise.

A more concrete example is the inability of various computer systems to share data across the NASA centers, programs, and even elements within programs. Trends across flights were not thoroughly examined because of both of these reasons: (1) it was thought to be the responsibility of another part of the Space Shuttle operations; and (2) the databases could not be easily shared to perform the analysis.

NASA Implementation Plan

The SSP has reorganized to establish the Space Shuttle SE&I Office. This Office has been established at the same level of the elements of Shuttle Program (Orbiter, SRB, Redesigned Solid Rocket Motor, Space Shuttle Main Engine, ET, and the KSC Launch and Landing Project). The charter at the Office is to be responsible for systems engineering and integration of all SSP ground and flight activities containing any two or more of the Space Shuttle project element. The Office reports directly to the SSP Manager.

The position of the office in the SSP will position it better in the information and decision forums, and therefore better to successfully carry on its integration responsibilities.

Ten new initiatives are under way including: (1) additional assets from the Aerospace Corporation; (2) establishment of an independent "Greybeard" assessment and panel; and (3) enhance integration workforce at the Manned Space Flight Centers.

Assessment

Obviously, the most critical aspect of these changes is how it all works in practice. Management Panel representatives attended one agency-wide workshop of the new Space Shuttle SE&I Office and received a briefing on December 9, 2003. NASA has begun hiring to virtually double the number of employees in the SE&I Office. This is still a "work in progress" which will evolve over the next several months. RFI's from NASA are still outstanding.

Future

The second "Integration Summit" involving all integration elements across the SSP is scheduled for early next year at the Kennedy Space Center. It will be difficult to further assess these actions until the Management Panel knows more about: the personnel assigned across the agency (with an eye toward the level cross-disciplinary expertise); the proposed lines of communication; and, a critical element not yet explicitly addressed by NASA, the compatibility and availability of necessary databases on engineering, vehicle drawings, flight data, and other relevant information stored at various sites within NASA. Eventually, the Management Panel will conduct interviews of individual members of the integration team.

Status

Plan – Well along
Implementation – Just Beginning
Outstanding RFI's – 1 Open
Overall Status – Open

CAIB Recommendation 9.1-1 – Detailed Plan for Organizational Change

Prepare a detailed plan for defining, establishing, transitioning, and implementing an independent Technical Engineering Authority, independent safety program, and a reorganized Space Shuttle Integration Office as described in R7.5-1, R7.5-2, and R7.5-3. In addition, NASA should submit annual reports to Congress, as part of the budget review process, on its implementation activities.

RTF TG Interpretation

The three specific recommendations—organizational changes to be incorporated in the plan—are addressed separately above. Embodied in Recommendation 9.1-1, however, are the many less tangible issues raised by the CAIB, such as "culture." It is therefore in the context of this recommendation that the Management Panel will attempt to address the overarching, organization-wide issues raised by the CAIB.

NASA Implementation Plan

NASA's response has been that they will strictly comply and create the "independence" and "integration" called for by CAIB. NASA has also responded in ways not suggested or otherwise required by the accident report. For example, the Director of the Goddard Space Flight Center is conducting an analysis of the applicability of the CAIB recommendations to the rest of NASA—the CAIB Agency-Wide Action Team. There is not yet a unified plan for addressing "culture."

Assessment

The subjective nature of "culture," which invites "…I'll know it when I see it…" interpretation, makes it difficult to clearly establish objectives for NASA's actions. In one sense, the requirement is only to develop a plan to implement the three specific items listed, items which may affect culture, but which taken alone do not address the larger organizational issues. The Management Panel is considering aspects of organizational culture that should be considered in an attempt to develop some metrics and measurements and will be seeking these metrics from NASA.

Further, the Management Panel, as well as many members of the Task Group, are concerned that there is as much risk as opportunity in the implementation of recommendation 9.1-1. If lines of responsibility and accountability are confused by, for example, the creation of an "independent safety program," personnel working in the SSP may feel somehow relieved of safety responsibilities. More generally, it is presently unclear even within NASA where the final accountability will lie for responsibilities removed from the SSP, particularly for safety and technical requirements

Another critical aspect of the operation of the SSP, not explicitly addressed in Recommendations 7.5-1 through 7.5-3 has been the establishment of technical requirements for the Space Shuttle and related systems and, in turn, the ability (and authority) to seek waivers to these requirements. The use of waivers has been a point of much public criticism, including most recently by former

astronaut and Senator John Glenn.

The use of waivers is being investigated more fully by the Technical Panel of the Task Group. However, the use of waivers is an aspect of "culture" criticized by the CAIB and needs to be understood in the larger context of NASA's operations.

The term "requirements" as used in the SSP, might best be understood as "objectives"—many of the requirements appeal to a perfect system or ideal conditions which are rarely met, or include the requirement for redundant systems that cannot be tested except in use. As such, every Space Shuttle flight has entailed the issuance of several thousand waivers, often to components or systems deemed the most critical to safe and successful flight.

The Nuclear Submarine Program in the Navy, for example (a formal comparison of which had begun at NASA even before Columbia's failure) treats requirements and waivers quite differently. The technical requirements for the reactor and propulsion systems of a submarine are essentially inviolate and not subject to waiver, as are many other aspects of the submarine systems the failure of which could result in sinking. Less critical requirements may be subject to waiver.

This distinction of requirements between Space Shuttles and submarines can be characterized, on its face, as largely definitional; e.g., reducing Space Shuttle "requirements" from objectives to actual flight requirements could eliminate the need for waivers in many cases.

However, in practice the processes can produce different outcomes. NASA might argue that their approach promotes continual improvement, produces results that often exceed more minimal flight requirements, force the mitigation of risk through the waiver process, and is the only process possible when many components are essentially destroyed by their use. Critics, however argue that the ability to grant waivers to requirements, especially when in the hands of the SSP manager who is also under pressures to perform on schedule and budget, may lead to more trade-offs against safety and result in higher risk.

All of this is to say: The questions of who has the responsibility to establish requirements, the authority to waive requirements, and the accountability for the consequences of both are important elements of defining a successful organization and a critical aspect of its culture. The Management Panel does not have clear insight yet into how NASA will ultimately address these issues, how the NESC fits into the overall process, or how "independence" will be defined and sustained by NASA.

Future

The Management Panel will seek in the ensuing months before the next launch: 1) clear and strict lines of authority and accountability for safety, schedule and resources; 2) the role of the establishment of technical requirements and any waivers thereto; 3) the clear delineation of lines of communication up through the organization; 4) reassessment of basic assumptions held by NASA management underlying the Space Shuttle's performance and operations; 5) the agency-wide effects of personnel (and budgeting) policies and practices surrounding the new authorities; and 6) the systematic measurement and audit of the effects (integration and sustainability) of these

recommendations on NASA's "culture", including the potential for unintended consequences. Additional RFI's are anticipated.

Status

Plan – Undeveloped
Implementation – N/A
Outstanding RFI's – 6 Open
Overall Status – Open

CAIB Recommendation 10.3-1 – Digitize Closeout Photos

Develop an interim program of closeout photographs for all critical sub-systems that differ from engineering drawing. Digitize the closeout photograph system so that images are immediately available for on-orbit troubleshooting.

RTF TG Interpretation

During the investigation, the CAIB encountered numerous engineering drawings that were inaccurate. Further, they discovered that a large number of engineering change orders had not been incorporated into the drawings. Tied in with this, CAIB investigators were not able to access needed closeout photography for several weeks. This resulted in the following finding:

F10.3-3 *NASA normally uses closeout photographs but lacks a clear system to define which critical subsystems should have such photographs. The current system does not allow the immediate retrieval of closeout photos.*

NASA Implementation Plan

The NASA Photo Team is working to establish a more precise definition of "closeout photography" and to strengthen program documentation requirements. KSC has an active program involving digitized closeout photography and has, over several years, collected a large database. The database is available to MSFC and JSC on the Internet in the SIMS. While the SIMS is not necessarily "user friendly" and requires knowledge of the system, the data is indexed and available to users, including offsite KSC, in a timely manner. An initiative (prior to the Columbia flight) to revise the SIMS index software to make it more "user friendly" was in progress and is now a priority. The new software should greatly improve this problem.

Current camera equipment used by Space Shuttle inspectors are being evaluated to identify possible improvements, including standardization of the cameras at all KSC processing facilities. The inspectors are trained in the use of the equipment and a random "quality check" is made of their photos to determine if additional training is required.

Assessment

RTF TG Operations Panel members met with KSC and their contractors to review the response to the recommendation. The indexing software revisions to SIMS will make the system more "user friendly" and should be a major improvement. This effort should continue as a priority. In the interim, provisions should be made to have personnel familiar with the current system available to assist anyone who needs the photos. This should be a part of the RTF practice exercises.

As the Photo Team is struggling with defining the requirements for closeout photography, the users (such as the Program Office and Mission Evaluation Room) should review their requirements immediately. Vehicles Discovery and Atlantis are being processed and various closeouts are being accomplished daily. Specifically, the Program Office should identify those

areas that may require photographs to support the technical evaluation of in-flight problems occurring in critical systems.

Future

RTF Operations Panel meetings with the SSPO are scheduled during December to address the Panel's assessment. The Operations Panel will continue to review the progress of implementation of the above actions.

Status

Plan – In Progress
Implementation – In Progress
Outstanding RFI's - None
Overall Status – Open

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A - Return to Flight Task Group Charter

ESTABLISHMENT AND AUTHORITY

The NASA Administrator, having determined that it is in the public interest in connection with performance of the Agency duties under the law, and with the concurrence of the General Services Administration, establishes the NASA Return to Flight Task Group, pursuant to the Federal Advisory Committee Act (FACA), 5 U.S.C. App. §§ 1 et seq.

PURPOSE AND DUTIES

1. The Task Group will perform an independent assessment of NASA's actions to implement the recommendations of the Columbia Accident Investigation Board (CAIB), as they relate to the safety and operational readiness of the next flight. As necessary to its activities, the Task Group will consult with former members of the CAIB.
2. While the Task Group will not attempt to assess the adequacy of the CAIB recommendations, it will report on the progress of NASA's response to meet the intent.
3. The Task Group may make other such observations on safety or operational readiness, as it believes appropriate.
4. The Task Group will draw on the expertise of its members and other sources to provide its assessment to the Administrator. The Task Group will hold meetings and make site visits as necessary to accomplish its fact-finding. The Task Group will be provided information necessary to perform its advisory functions, including activities of both the Agency and its contractors.
5. The Task Group will function solely as an advisory body and will comply fully with the provisions of the FACA.

ORGANIZATION

The Task Group is authorized to establish panels in areas related to its work. The panels will report findings and recommendations to the Task Group.

MEMBERSHIP

1. In order to reflect a balance of views, the Task Group will consist of non-NASA employees and one NASA non-voting, ex officio member, the Deputy Associate Administrator for Safety and Mission Assurance. In addition, there may be associate members selected for Task Group panels. The Task Group may also request appointment of consultants to support specific tasks. Members of the Task Group and panels will be chosen from among industry, academia, and Government with recognized knowledge and expertise in fields relevant to safety and space flight.

2. The Task Group members and the co-chairs of the Task Group will be appointed by the

Administrator. At the request of the Task Group, associate members and consultants will be appointed by the Associate Deputy Administrator (Technical Programs).

ADMINISTRATIVE PROVISIONS

1. The Task Group will formally report is results to NASA on a continuing basis at appropriate intervals, including a final written report.
2. The Task Group will meet as often as required to complete its duties and will conduct at least two public meetings. Meetings will be open to the public, except when the General Counsel and the Agency Committee Management Officer determine that the meeting or a portion of it will be closed pursuant to the Government in the Sunshine Act or that the meeting is not covered by FACA. Panel meetings will be held as required.
3. The Executive Secretary will be appointed by the Administrator and will serve as the Designated Federal Officer.
4. The Office of Space Flight will provide technical and staff support through the Task Group on International Space Station Operational Readiness. The Office of Space Flight will provide operating funds for the Task Group and panels. The estimated operating costs total approximately $2 million, including 17.5 work years for staff support.
5. Members of the Task Group are entitled to be compensated for their services at the rate equivalent to a GS 15, step 10. Members of the Task Group will also be allowed per diem and travel expenses as authorized by 5 U.S.C. § 5701 et seq.

DURATION

The Task Group will terminate two years from the date of this charter, unless terminated earlier or renewed by the NASA Administrator.

_____ _____

Sean O'Keefe (signature on file at NASA Headquarters) Date
Administrator

Appendix B - RTF TG Membership

Co-Chairman of the Return to Flight Task Group

Lt. Gen. Tom Stafford USAF (Ret), Chairman, NASA Advisory Council Task Force on International Space Station Operational Readiness (Stafford Task Force), President, Stafford, Burke & Hecker Inc., Astronaut (Gemini 6A, Gemini 9A, Apollo 10, CDR of the Apollo-Soyuz Test Project)
Mr. Richard Covey, Vice President, Support Operations, Boeing Homeland Security and Services, Astronaut (STS-51I, STS-26, STS-38, and STS-61)

Task Group Members

Colonel Jim Adamson, U.S. Army (Ret.), CEO, Monarch Precision, LLC, Astronaut (STS-28 & 43)
Major General Bill Anders U.S. Air Force (Ret.), Retired Chair and CEO of General Dynamics Corporation, Astronaut (Apollo 8)
Dr. Walter Broadnax, President, Clark Atlanta University
Rear Admiral Walter Cantrell, U.S. Navy (Ret.), Consultant, Member Aerospace Safety Advisory Panel, Former Commander, Space and Naval Warfare Systems Command
Dr. Kathryn Clark, Vice President for Education, TIVY, Incorporated
Mr. Ben Cosgrove, Senior Vice President, Boeing Commercial Airplane Group (Retired)
Mr. Dan Crippen, Former Director of the Congressional Budget Office
Mr. Joe Cuzzupoli, Vice President and K-1 Program Manager, Kistler Aerospace Corporation
Dr. Charles Daniel, Engineering Consultant, Stafford –Anfimov Task Force
Dr. Richard Danzig, JD, Director of National Semiconductor Corporation and Human Genome Sciences, Senior Fellow, Center for Naval Analysis
Dr. Amy Donahue, Assistant Professor of Public Administration, University of Connecticut
General Ron Fogleman, U.S. Air Force (Ret.), President and COO of Durango Aerospace Incorporated
Ms. Christine A. Fox, Vice President and Director, Operations Evaluation Group, Center for Naval Analyses
Mr. Gary Geyer, Aerospace Consultant, Served for 26 years with the NRO
Colonel Susan J. Helms, U.S. Air Force, Division Chief, Space Superiority Division, Air Force Space Command, Astronaut (STS-54, STS-64, STS-78, STS-101, and ISS 2)
Mr. Richard Kohrs, Chief Engineer, Kistler Aerospace Corporation
Mrs. Susan Livingstone, Former Under Secretary of the Navy
Lieutenant General Forrest McCartney, USAF (Ret.), Aerospace Consultant, Member Aerospace Safety Advisory Panel, Former Director of Kennedy Space Center
Dr. Rosemary O'Leary, Professor of Public Administration, Syracuse University
Dr. Decatur Rogers, Dean, Tennessee State University College of Engineering, Technology and Computer Science
Mr. Sy Rubenstein, Aerospace Consultant, Former Rockwell International Director of Systems Engineering
Mr. Robert Sieck, Aerospace Consultant, Member Aerospace Safety Advisory Panel, Former Director of Shuttle Processing, Kennedy Space Center
Mr. Thomas N. Tate, Retired former Vice President of Legislative Affairs for the Aerospace Industries Association
Dr. Kathryn C. Thornton, Professor, University of Virginia School of Engineering & Applied Science, Astronaut (STS-33, STS-49, STS-61)
Mr. Bill Wegner, Consultant, Former Deputy Director to Admiral Rickover in Nuclear Navy Program

Task Group Support

Ex Officio Member: Mr. James Lloyd, Deputy Associate Administrator, Office of Safety & Mission Assurance, NASA Headquarters
Executive Secretary: Mr. David Lengyel, NASA Headquarters
Astronaut Representative: Mr. Carlos Noriega

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix C - Return to Flight Task Group Organization Structure

CO-CHAIRMAN
Lt. Gen. Tom Stafford

ASTRONAUT REP
Mr. Carlos Noriega

CO-CHAIRMAN
Mr. Richard Covey

EXEC. SECRETARY
Mr. David Lengyel

MANAGEMENT PANEL
Dr. Dan Crippen

Maj. Gen. Bill Anders
Dr. Walter Broadnax
Hon. Richard Danzig
Gen. Ron Fogleman
Mr. Gary Geyer
Mrs. Susan Livingstone
Mr. Tom Tate
Mr. Bill Wegner

TECHNICAL PANEL
Mr. Joe Cuzzupoli

RADM Walt Cantrell
Mr. Ben Cosgrove
Dr. Chuck Daniel
Mr. Richard Kohrs
Dr. Decatur Rogers
Mr. Sy Rubenstein

OPERATIONS PANEL
Col. Jim Adamson

Dr. Kathy Clark
Dr. Amy Donahue
Ms. Christine Fox
Col. Susan Helms
Lt. Gen. Forrest McCartney
Dr. Rosemary O'Leary
Mr. Bob Sieck
Dr. Kathy Thornton

EX OFFICIO
Mr. James Lloyd

Editorial Sub-Panel

Dr. Dan Crippen
RADM Walt Cantrell
Dr. Rosemary O'Leary

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix D - RTF TG Fact-Finding Activities

August

August 5-7, 2003	Kennedy Space Center (KSC), Plenary Session, Public Meeting
August 18, 2003	Johnson Space Center (JSC), Mr. Geyer, NASA-National Imagery and Mapping Agency (NIMA) Memorandum of Understanding (MOU)
August 19-20, 2003	JSC, Dr. Crippen discussions with SSPO, USA, and Boeing Management
August 21, 2003	Videoconference, Space Flight Leadership Council (SFLC) Meeting
August 25, 2003	KSC, Lt. Gen. McCartney, Mr. Sieck, Ground-based Imagery Discussions
August 27, 2003	Lockheed Martin Missiles and Fire Control, Dallas, TX, Technical Panel, RCC NDE
August 28, 2003	Michoud Assembly Facility (MAF), New Orleans, LA, Technical Panel, External Tank (ET) RTF Status

September

September 2, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
September 9, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
September 9-11, 2003	JSC, Plenary Session
September 16, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
September 17, 2003	House Science Committee (HSC) Members and Senior Staff visit, Mr. Tate, Mr. Covey, and Lt. Gen. Stafford
September 18, 2003	JSC, Mr. Cuzzupoli, Dr. Clark, Extravehicular Activity Tile and Reinforced Carbon-Carbon (RCC) Repair
September 23, 2003	NASA Headquarters, Management Panel
September 24, 2003	KSC, Lt. Gen. McCartney, Mr. Sieck, Foreign Object Debris (FOD) and Non-Destructive Evaluation (NDE)
September 28, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
September 30, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
September 30, 2003	MAF, New Orleans, LA, Mr. Kohrs and Dr. Rogers, ET RTF Status

October

October 3, 2003	Videoconference, SFLC Meeting
October 7, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
October 8, 2003	KSC, Lt. Gen. McCartney and Mr. Sieck, Waivers and Deviations for KSC Ground Support Equipment (GSE)
October 14, 2003	Washington, D.C., Mr. Geyer, NASA-NIMA MOU
October 14, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff

October 15, 2003	JSC, Mr. Geyer, Space Shuttle Program Systems Engineering and Integration Office organization workshop.
October 17, 2003	Teleconference, Management Panel Bi-weekly Tag Up
October 20, 2003	KSC, Lt. Gen. McCartney and Mr. Sieck, Ground-based Imaging.
October 20, 2003	HSC Senior Staff visit, Mr. Tate and Mr. Wegner
October 22-23, 2003	Ogden, UT, Mr. Cuzzupoli and Mr. Cosgrove, Program Managers Review
October 23, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
October 27-28, 2003	NASA Headquarters, Submarine Safety Colloquium, Management Panel
October 28-30, 2003	JSC and Southwest Research Institute, San Antonio, TX, Thermal Protection System Meetings
October 29-30, 2003	Cape Canaveral, Lt. Gen. McCartney, Mr. Sieck, Mr. Lengyel, Shuttle Service Life Extension Program Summit
October 30, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
October 31, 2003	Atlantis Nosecap NDE Telecon, Technical Panel
October 31, 2003	Teleconference, Management Panel Bi-weekly Tag Up

November

November 4, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
November 5-30, 2003	Marshall Space Flight Center, Dr. Daniel, Bolt-catcher Critical Design Review
November 14, 2003	Teleconference, Management Panel Bi-weekly Tag Up
November 18, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
November 20, 2003	JSC, Dr. Crippen, Management Meetings
November 20, 2003	JSC, Mr. Tate, Mission Management Team (MMT) Normal Accident Theory
November 21, 2003	JSC, SFLC Meeting
November 25, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
November 28, 2003	Teleconference, Management Panel Bi-weekly Tag Up

December

December 1-5, 2003	JSC, Mrs. Livingstone, MMT Simulation (Flight 12A.1)
December 2, 2003	MAF, New Orleans, LA, Technical Panel, ET Status
December 3, 2003	KSC, Lt. Gen. McCartney and Mr. Sieck, Digital Closeout Imagery
December 4, 2003	Teleconference, Task Group Tag Up, Leadership and Core Staff
December 9-11, 2003	JSC, Plenary Session
December 11-12, 2003	JSC, Editorial Sub-Panel

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix E - RFI Status Matrix

Number	Title	Description	12/12/2003
Tech-001	R3.3-1 Rationale for Retaining OV104 Nose Cap Rather than Testing	Provide the rationale for retaining the OV104 nose cap in place rather than performing the tests being performed on the OV103/OV105 nose caps.	CLOSED
Tech-002	R3.3-2 Tile Improvements for First Flight	What are the tile improvements for the first flight? If the improvements were selected to reduce risk please explain the rationale or testing underway to demonstrate why the changes are not required.	CLOSED
Tech-003	R3.3-2 Tile Improvements Testing	What testing (schedule and type) will be done to demonstrate the tile repair prior to first usage?	CLOSED
Tech-004	Wind Tunnel Testing on External Tank	Per our discussion, I would like to understand what wind tunnel cases are being run for the ET bi-pod and PAL ramp. I understand that these are ET only configurations. I am interested in MACH numbers, angle of attack, beta angle, etc. I am also interested in what CFD analysis or planned mated vehicle tests are planned to understand the effects of any changes. I am concerned that the changes to the ET may affect the system unless we understand the mated aero effects.	CLOSED
Tech-005	R3.3-2 Testing Information on RCC and tile Testing	Provide an integrated schedule of testing to support R.3.3-2,…"a program designed to increase the orbiters ability to sustain minor debris damage by measures such as improved impact resistant RCC and acreage tiles." Please explain the approach to demonstrate the margin between the ET shedding and the Orbiter damage tolerance. Provide information for the RCC and tile testing.	CLOSED
Tech-006	TPS Repair Testing Reports Including Astronaut Crew Consensus Report	Pre "Press Day" Inspection and Demos of Tile and RCC repair tools. Informal Q&A and follow-up discussions. Glove Box demonstration for selected TG members. TG fact finding & planning session.	N/A
Tech-007	Additional Instrumentation for vehicles ET FOAM (R3.2.1)	What additional instrumentation will be added to the vehicles to obtain engineering data to verify pre-flight predictions, primarily concerning RCC and tank debris. Also, please provide the PRCB status addressing adding instrumentation to record impacts to the RCC leading edge and data availability near real-time to the ground and the program's position on implementation.	OPEN

Appendix E - RFI Status Matrix

Tech-008	Additional Instrumentation for ET for Pre-Launch and Launch (R3.2.1)	The technical team is interested in what additional instrumentation is planned to be added to the External Tank (ET) to measure the environments during pre-launch and launch. The removal of the bipod ramps, and potentially the removal of the PAL ramps, and the uncertainty of the internal intertank environment of the LH tank interface creates the justification to add instrumentation to obtain engineering data and to facilitate the verification process.	OPEN
Tech-009	Ascent Profile	Would like to see a typical ascent profile that shows alpha, beta thrust bucket, propellant consumption, altitude and velocity.	CLOSED
Tech-010	ET Finite Element Model (FEM)	Provide results from FEM analysis on ET. Identify the model, assumptions, data targeted, uncertainty, how data was used, load(s), etc.	OPEN
Tech-011	SRB Bolt Catcher Finite Element Model	Provide the results from the FEM used to analyze the SRB bolt catcher assembly. Identify model, assumptions, loads, uncertainty, data targeted, etc.	OPEN
Tech-012	Tile Repair Materials	1. Provide material specifications for 511 materials. 2. Provide material specification on silicon material.	CLOSED
Tech-013	Environment Testing of Tile Repair Materials	Provide briefing to Tech Panel describing the combined environments testing on the tile repair material, i.e. vacuum, temperature, loads, etc.	CLOSED
Tech-014	Briefing - Tile Repair Materials Procedure	Provide briefing to Tech Panel explaining how tile repair material and procedures will account for and control material expansion protecting for 1/4" step.	Closure Pending Cuzzupoli's signature
Ops-015	TPS Inspection/Repair Media Day Demo and KC-135 Test Video and Transcripts	Provide videos and transcripts for the following: 1. Tile and RCC inspection and repair explanations and EVA tool/techniques demonstrations provided by JSC in Building 32 on either September 17 or 18, 2003 for Media Day. 2. Video tapes of KC-135 tests from 1979-1981 and some representative videos from more recent test in 2003 for tile repair techniques and material testing. These videos should illustrate basic tools, techniques and materials that were studied.	Closed
Ops-016	ISS Consumable, Sparing and Configuration for 2-Member Crew	Provide current and projected consumables (water, propellant, CO2 removal capability, food and other crew provisioning) for current 2-member crew with projected needs on Russian assets (e.g. Soyuz rotations, crew rotations, Progress missions, etc.) for extended on-orbit maintenance of ISS without Shuttle availability. Also provide data on critical ORU sparing to maintain minimum acceptable habitability and mechanisms for providing that sparing without Shuttle.	Closed

Appendix E - RFI Status Matrix

Ops-017	Contingency Shuttle Crew Support Data and Supporting Analysis	Provide minimum ISS system requirements, consumables, etc. to maintain crew of 6-10 for contingency support of the Shuttle crew. Provide plans for use of Soyuz to bring down partial crew and length of time remaining crew can survive on ISS. Provide plans and timeframes for sending additional Soyuz and/or Shuttle rescue missions to retrieve remaining crew members. Provide forward work to verify feasibility of this concept and reliance on Russian segment and assets.	Closed
Ops-018	ISS Safe Haven and ISS Extended Duration Orbiter Study Results	Provide study results from ISS Program led analysis of the ISS as a safe haven to provide larger on-orbit crew size with limited Soyuz return capability. Also provide study results from ISS Program led analysis of use of EDO Shuttle missions to provide a larger crew for utilization. Both study results should discuss ISS minimum system capability, consumables projections, number of crew supported as a function of time, and reliance on Russian segment and other assets	Closed
Ops-019	TPS Repair/Inspection Points of Contact and Concept of Operations	Provide contact information for the Program manager, operations lead, technical lead, and integrator (Program or otherwise; person who is insuring various parallel path items are coming together) for TPS repair/inspection techniques, testing, training and verification. Provide a summary of the concept of operations for any and all TPS repair/inspection techniques under evaluation and provide methodology for certifying for flight.	Closed
Ops-020	TPS Repair/Inspection Test Reports (part 1)	Provide copies of all test reports for any methods of TPS repair/inspection techniques and application processes under evaluation with any applicable crew consensus reports.	OPEN
Ops-021	TPS Repair/Inspection Test Reports for future tests - Part 2	Provide copies of all test reports for any methods of TPS repair/inspection techniques and application processes under evaluation with any applicable crew consensus reports for future planned tests.	OPEN
Tech-022	Wiring Inspection and Repair (R4.2-2)	What wiring inspection and repair will not be performed on OV-104 prior to return to flight. Provide rationale.	OPEN
Tech-023	Pull Test on High Temperature Tiles (R6.4-1)	Are there any plans to perform either a sampling or a 100% pull test on high temperature tiles/TPS prior to return to light. Provide rationale.	OPEN

Appendix E - RFI Status Matrix

Tech-024	Vehicle Re-certification & Hardware Qualifications/Certification Limits	CAIB recommendations9.2-1 to conduct a vehicle re-certification. SSP action 13 also discusses NASA's plan for hardware to access whether the hardware is being operated within the qualification and certification limits. The Technical Panel would like a briefing describing details of the process and plan for implementing these two activities.	Open
Man-025	MMT Training Plan And Schedule RE CAIB 6.3-1	1. NSTS 0700 Volume VII with changes pertaining to MMT annotated. 2. Schedule for MMT exercises and drills. 3. Simulation control group organization plan. 4. Outline of individual and team training for scheduled exercise. 5. MMT POC and read-ahead materials for RTF TG December plenary	OPEN
Man-026	Budget Impact on Scheduling and Resources 6.2-1	1. Debrief of FY04 budget process. 2. Notional budget allocation process. 3. Changes in budget allocation process resulting from Columbia mishap. 4. How Level 2 tools are used to fulfill Level 1 requirements. 5. Copy of benchmarking.	OPEN
Man-027	Human Resources, Organization and Culture 6.2-1 and 9.1-1	1. Presentation of NASA's Strategic Human Capitalization Plan. 2. Presentation of Succession Plan. 3. How NASA has gathered feedback from the workforce regarding moral, views on culture, etc. 4. Presentation of NASA's plan to balance civil service and contractor workforce. 5. Presentation of NASA's Conflict Management Plan. 6. Impact of NESC stand up on line organizations. 7. Forward plan for civil service workforce structure (e.g., percentage of increase and decrease per skill and grade, increase and decrease of temporary and permanent positions). 8. Code F and NAWAT interfaces and functional relationships.	Open
Man-028	NASA/NIMA MOA Plans and Documentation R6.3-2	1. Master schedule for development, coordination, publication and implementation (to include simulation and test) 2. MOA (classified) 3. Clearance list/process description 4. Description of NASA STRATCOM/Interface 5. Presentation of plan to Incorporate STRATCOM ground based assets 6. Standard operating procedures 7. Training plan 8. Integrated simulation/evaluation results	OPEN

Appendix E - RFI Status Matrix

Man-029	Space Shuttle Systems Engineering Office (MS) Reorganization plans, resources, and documents, R7.5-3 (rolls into R9.1-1)	1. MS reorganization milestones and master schedule 2. MS meeting and workshop schedules, agendas and presentation materials 3. MS organization and process documents (e.g., white papers, memoranda, etc.) 4. Presentation of MS reorganization budget and resources	OPEN
Man-030	Lessons Learned from First MMT Simulations, R6.3-1	1. Report on lessons learned from first MMT simulation. 2. Quick look results from second MMT simulation.	OPEN
Tech-031	SSME Controller Software Independent Verification and Validation (I V V), Other no Rec.	Request clarification of the Space Shuttle Program Policy for IVV and descried the IVV process for the SSME controller software. Background: The Technical Panel Lead discussed SSME controller software IVV with Rocketdyne's Chief engineer. The Chief Engineer describe a process that indicated that the IVV of the Rocketdyne development software was also performed by Rocketdyne. Normal practice for IVV is to use an independent IVV contractor.	OPEN
Man-032	CAIB Agency Wide Action Team (CAWAT) Status, R6.2-1 and 9.1-1	1. Brief CAWAT's current status. 2. CAWAT Master Schedule. 3. CAWAT benchmarking/milestones 4. Address CAWAT's conceptual approach to enable NASA's compliance with CAIB recommendation, particularly R6.2-1 and R9.1-1.	OPEN
Man-033	Detailed Organization Plan, R9.1-1	1. Status of Organization Plan.2. Brief of notional approach.3. Presentation of metrics, milestones, and Master Schedule.4. Rationale for separating R7.5-3 from R9.1-1, R7.5-1, and R7.5-2 in Implementation Plan.5. Rationale for assignment of overall responsibility for R9.1-1 implementation to a center individual vice HQ Code, particularly in light of Code Q responsibility for R7.2-1 and R7.5-2.6. Schedule for periodic briefs to RTF TG Management Panel and presentation of options development, risk/benefit analyses, decisions, and progress.	OPEN
Man-034	Organization Plan Interdisciplinary Assessment Team, R9.1-1	1. Personnel assigned, parent organization(s), and team structure. 2. Team charter and reporting chain. 3. Meeting schedules, locations, agendas, and coordinator's contact information. 4. Meeting minutes, presentation material, and supporting documentation. 5. Team recommendation and dates of completion and final report.	OPEN

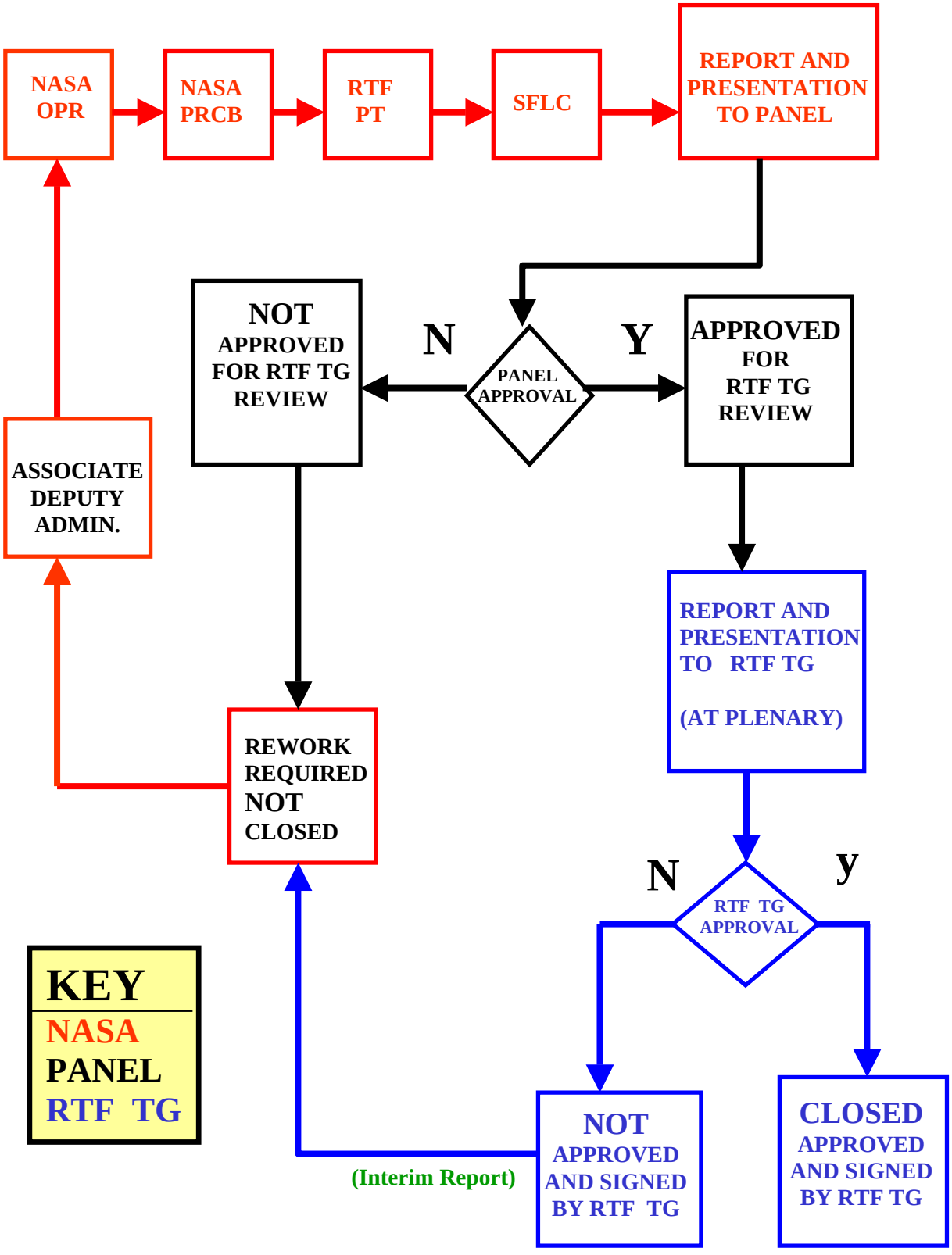
Appendix E - RFI Status Matrix			
Man-035	ITEA and S&MA Concepts, R7.5-1, R7.5-2, and R9.1-1	1. How does NASA define "independent" and "independently" as referred to in R7.5-1 and R7.5-2? 2. Notional approach to contractor technical expertise vis-à-vis "independence" criteria and anticipated contract modifications. 3. Notional concept separating technical authority from other programmatic functions (e.g., corollary to NAVSEA's warrants/veto authority). 4. Risk/benefit analysis of separating final technical and safety authority from line management. Address distinction between centralized safety line authority and "safety is everyone's responsibility." 5. NASA's plan to address "High Reliability Theory" versus "Normal Accident Theory" referred to in the CAIB Report.	OPEN
Man-036	NASA HQ S&MA Line Authority, R7.5-2 and R9.1-1	1. Present pre-mishap Shuttle safety responsibility and authority (specifying levels of final accountability), to include contractor roles. 2. Present annotated changes to number 1, above, delineating specific improvements and rationale for change. Include interfaces and functional relationships with NESC.	OPEN
Man-037	ITEA and NESC Status, R7.5-1 and R9.1-1	1. Brief status of 14 common themes and concerns delineated in September 2003 White Paper subsequent to NESC tour, as well as other concerns raised during briefings to Congress. 2. Brief current NESC staffing, personnel acquisition sources, and budget and funding source(s). 3. Provide NESC oversight matrix, organizational interfaces, and functional relationships. 4. Discuss lessons learned/observations from 27 October Submarine Safety Colloquium, including planned incorporation into NESC's organization and operational concepts. 5. Assessment of NESC's added value to a notional Columbia mishap scenario. 6. Is NESC NASA's response to R7.5-1? If not, present NASA's response to R7.5-1 as delineated in R9.1-1.	OPEN

Appendix E - RFI Status Matrix

Ops-038	Sensor/Optics Product Integration for Real-Time Ops Mission Support	1. Diagram and describe the integrated technical and operations effort to satisfy: (a) Imaging the Orbiter during ascent from the KSC/Canaveral ground sites; (b) Imaging the Orbiter from external tank/SRB-mounted cameras; (c) Imaging the external tank from wheel-well cameras and crew hand-held cameras; (d) Imaging the Thermal Protection System (TPS) using boom-mounted laser; and (e) Imaging the TPS using ground/space-based assets.2. Diagram and describe how the products from items 1a-1e above will be integrated to support real-time operations decisions.	OPEN
Tech-039	GMIP's Independent Assessment	RTF TG Technical Panel requests a copy of the NASA Independent Assessment Report on GMIP's.	OPEN
NONE-040		NO # 40 RFI Omitted by mistake	N/A
Tech-041	Conduct an "Integrated Imagery/Sensor Inspection" Workshop	1) Ground-Based Sensors Status 2) ET/SRB Sensors Status 3) OBSS Status 4) Umbilical Well Camera Status 5) Hand-Held Camera Status 6) Inspection Requirements, Standards, Criteria 7) Integrated Risk Assessment 8) NASA/NIMA Operational Approach 9) Resolution Requirements 10) Inspection Timeline & Decision Making Process (MMT) 11) Collection/Integration of Sensor Products/Data 12) Real-Time Ops Procedures 13) Training (crew, Controller, MMT) 14) DTO's 15) Contract(s) Structure 16) Integration with Other Instrumentation 17) Revision to NSTS Requirements Documents 18) Budget 19) Integrated Schedule/Critical Path/Key Milestones 20) Role of SEIO 21) Integration of Inspection with EVA Repair 22) Non-Advocate Review Plans This workshop should include outside experts in Optics, Laser, Software Integration, and Classified Data Gathering/Integration from Government, Industry, and/or Academia. Detailed minutes should be kept.	OPEN
Man-042	MMT Additional Lessons Learned, Outside Evaluation Reports, and Other CAIB Rec. Exercise, R6.3-1	1. Report on Lessons Learned from second MMT simulation. 2. Provide Parker and Van Eynde evaluations of first and second MMT simulations. 3. List aspects of other CAIB RTF recommendations exercised in MMT simulations. 4. List aspects of CAIB non-RTF recommendations exercised in MMT simulations	OPEN

Appendix E - RFI Status Matrix			
Man-043	NASA JSC Workforce Stress Level Survey Results, R6.2-1 and R9.1-1	1. Provide results from 2000 JSC Stress Survey and actions initiated to reduce identified stress levels. 2. Provide results from most recent JSC Stress Survey mentioned in JSC HR e-mail from JSC Center Director, dated 24 October 2003, and any additional actions contemplated to reduce identified stress levels.	OPEN
Man-044	Changes to NASA and SSP Waiver Processes, R7.5-1 and R7.5-2	If the Space Shuttle External Tank (ET) sheds foam and requires waiver(s) before flight, describe: 1. Waiver(s) required. 2. Process flow. 3. Who, by billet, decides at each level in the process flow? 4. Who, by billet, is ultimately responsible for granting waiver(s)? 5. Who, by billet, has veto authority? 6. How are cognizant organizations funded? -Describe processes as they existed at the time of the Columbia mishap and as envisioned in Option 1A presented by NASA's Code Q to members of the RTF TG on 10 December 2003.	OPEN

Appendix F - Process for Review, Signature, and Closure



THIS PAGE INTENTIONALLY LEFT BLANK

Appendix G - Request for Information Process (RFI) Flow

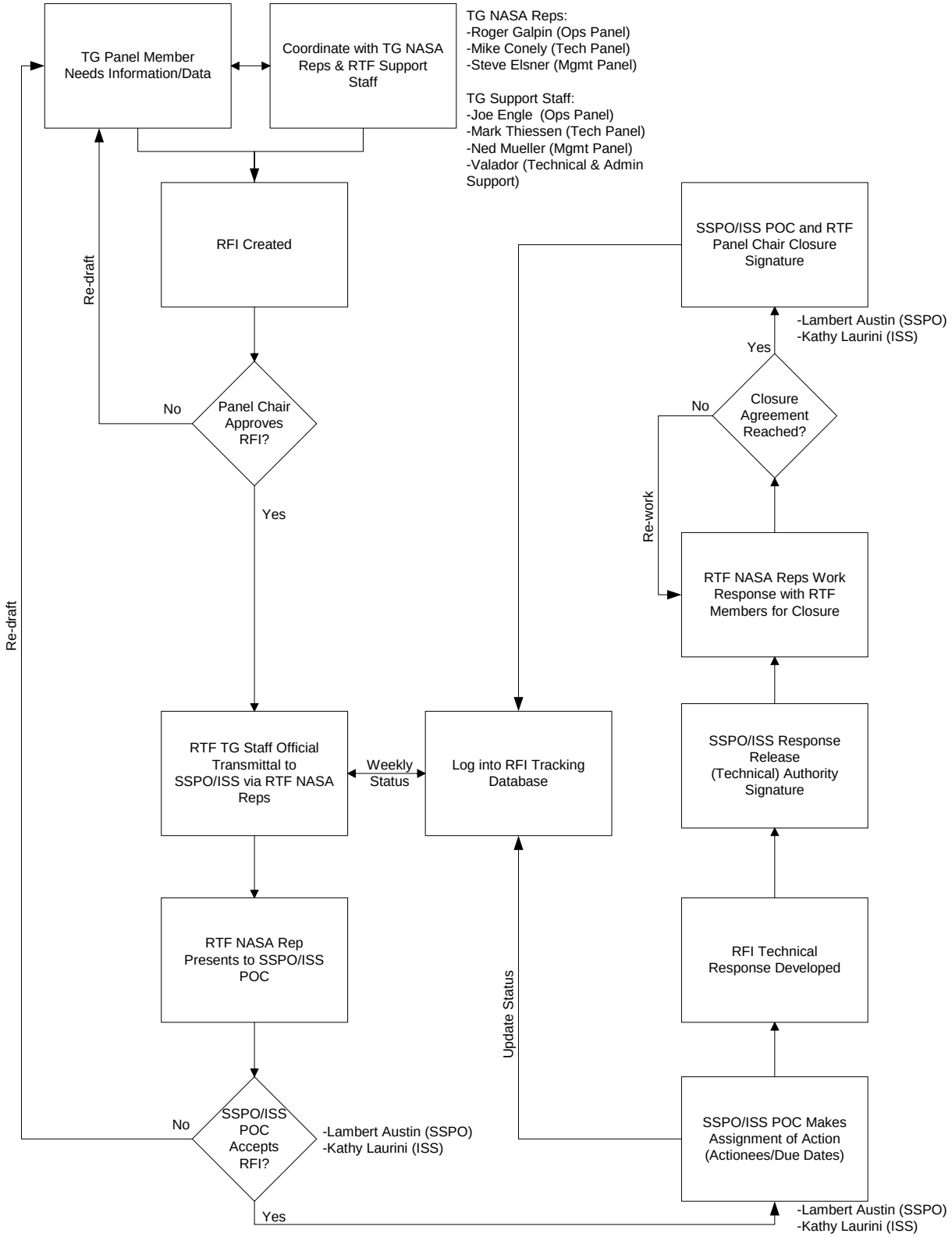
Figure 1 illustrates the process flow for RTF TG members to request information from NASA/contractors. This includes both the SSPO and ISS Office. When a TG member identifies a need for information, the NASA Panel representatives assigned to the RTF TG and the RTF TG Advisory Staff should be consulted about the request. In some cases, an official RFI might not need to be created, i.e., an existing event or meeting. However, once consultation is done and a request is still considered valid, an RFI will be created. Figure 2 illustrates the RFI form. Upon completion of the form, the RFI must be signed by the appropriate TG Panel Chairman and NASA Panel representative. At this point, the RFI is considered official and will be released to either the SSPO or ISS Office as appropriate. Concurrent with release to NASA, the RFI is logged into a tracking database maintained by RTF TG staff. The database will be used to keep track of the status of each RFI and maintain a centralized location for close out. RTF TG staff will coordinate with NASA Panel Representative and/or Points-of-Contact (POC) to track due dates, actionees, and status.

A NASA POC has been identified for both the SSPO and ISS Offices. All RFI's submitted by the RTF TG will be coordinated through these NASA POC's. The NASA POC's will have the authority to accept or reject the RFI before passing onto the appropriate office. Rejection of an RFI will result in the NASA Panel Representatives reworking the RFI for acceptability. Once the NASA POC accepts the RFI, due dates and actionees are assigned. This information will be fed back to the RTF TG staff for update of the tracking database.

The appropriate actionee(s) will develop the response to an official RFI. A response will only be considered official when signed by an SSPO/ISS Office Release Response (Technical) Authority. At this point, the NASA Panel Representatives will coordinate the official response with the TG member requesting the information. If the information is deemed acceptable, the NASA POC and the RTF TG Panel Chairman will sign the RFI form for official closure. The RFI form and associated response will then be uploaded to PBMA and the tracking database will be updated. RTF TG staff will also maintain a hard copy library of all RFI's and associated NASA responses.

Appendix G: Request for Information Process (RFI) Flow

Figure 1, RFI Flow



Appendix G: Request for Information Process (RFI) Flow

Date of Request: ____ **RTF Need Date:** ____ **Date Received:** ____	**Return To Flight (RTF)** **Task Group (TG)** **Action/Request for Information**	**Action No:** ____ **Reference No:** ____

Requestor: _____ Phone: _____ E-Mail: _____

Title: _____

Description:

Response Format: ☐ CD ☐ 3 ½" Disk ☐ Hard Copy ☐ E-Mail ☐ DVD ☐ Presented to: _____ ☐ Other Explain: _____ No. of Copies: _____	**RTF TG Approval of Request:** TG Panel Chair: _____ Date: _____ NASA Panel Rep: _____ Date: _____
SSPO/ISS Acceptance: Name: _____ Phone: _____ E-Mail: _____	**Action/Data Type:** ☐ Action ☐ Data Request

SSPO/ISS Actionee(s):

Name: _____ Phone: _____ E-Mail: _____

Name: _____ Phone: _____ E-Mail: _____

Name: _____ Phone: _____ E-Mail: _____

Actionee Due Date: _____

SSPO/ISS Response:

SSPO/ISS Response Release (Technical) Authority:

Approval: _____ Phone: _____ E-Mail: _____

Closure:

SSPO/ISS: _____ Date: _____
Signature

Accepted by TG: _____ Date: _____
Signature

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix H – RTF Integration Matrix

	TOPIC	ET TPS Modifications	Orbiter Hardening	RCC NDI	TPS on-Orbit Inspection	Ground Based Imagery	ET Sep Images	On-Vehicle Ascent imagery	NIMA MOA	SRB Bolt Catchers	2 – Person Closeout	FOD Processing	Scheduling - Resources	MMT Improvements	Reorg Plan	Digitize Closeout Photos	Contingency Crew Support
1	ET TPS Modifications																
2	Orbiter Hardening																
3	RCC NDI																
4	TPS on-Orbit Inspection																
5	Ground Based Imagery																
6	ET Sep Images																
7	On-Vehicle Imagery																
8	NIMA MOA																
9	SRB Bolt Catchers																
10	2-Person Closeouts																
11	FOD Processing																
12	Scheduling – Resources																
13	MMT Improvements																
14	Reorg Plan																
15	Digitize Closeout Photos																
16	Contingency Crew Support																

PRIMARY RELATIONSHIP
SECONDARY RELATIONSHIP
POTENTIAL RELATIONSHIP
NO RELATIONSHIP
UNDER EVALUATION
SELF

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix I - Acronyms

CAIB	Columbia Accident Investigation Board
CDR	Critical Design Review
ET	External Tank
ETA	External Tank Attachment
EVA	Extravehicular Activity
FACA	Federal Advisory Committee Act
FOD	Foreign Object Debris
FRCS	Forward Reaction Control System
IMMT	International Space Station Mission Management Team
ISS	International Space Station
ITEA	Independent Technical Engineering Authority
JSC	Johnson Space Center
KSC	Kennedy Space Center
L02/LOX	Liquid Oxygen
LH2	Liquid Hydrogen
MLGD	Main Landing Gear Door
MMT	Mission Management Team
MOU	Memorandum on Understanding
MPP	Manufacturing Process Procedures
MSFC	Marshall Space Flight Center
NASA	National Astronautics and Space Administration
NESC	NASA Engineering and Safety Center
NDE	Non-Destructive Evaluation
NDI	Non-Destructive Inspection
NIMA	National Imagery and Mapping Agency
NSI	NASA Standard Initiator
OSF	Office of Space Flight
RCC	Reinforced Carbon-Carbon
RFI	Request for Information
RTF TG	Return to Flight Task Group
S&MA	Office of Safety and Mission Assurance
SE&I	Systems Engineering and Integration
SFLC	Space Flight Leadership Council
SIMS	Still Image Management System
SRB	Solid Rocket Booster
SSPO	Space Shuttle Program Office
TPS	Thermal Protection System
USA	United Space Alliance
WLE	Wing Leading Edge

THIS PAGE INTENTIONALLY LEFT BLANK